

---

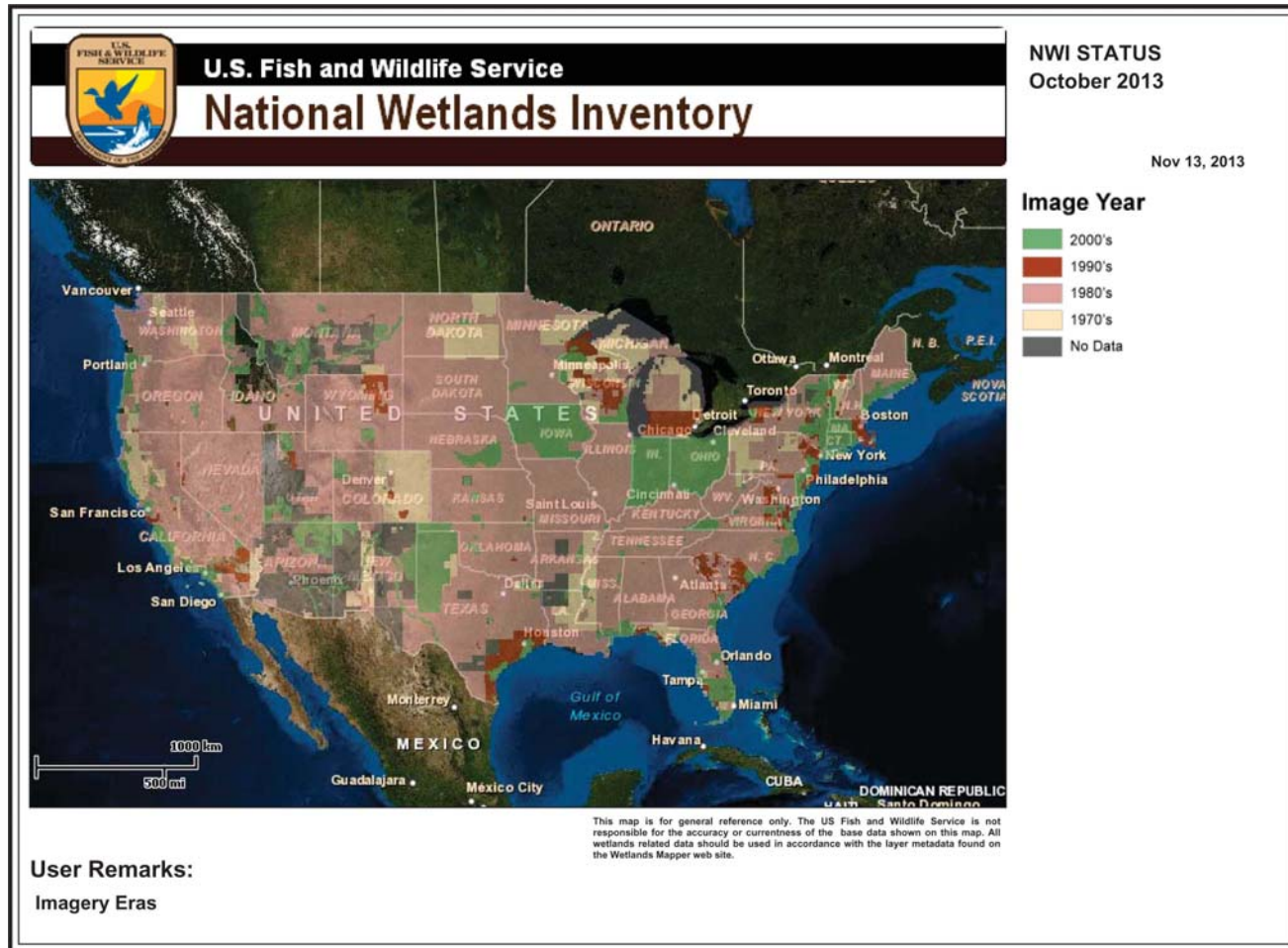
# NWI+ Data – What It Is and How It is Being Used

---

Ralph Tiner  
U.S. Fish & Wildlife Service  
Northeast Region, Hadley, MA  
November 20, 2013  
[ralph\\_tiner@fws.gov](mailto:ralph_tiner@fws.gov)

# National Wetlands Inventory (NWI)

- Mapping wetlands across the country since mid-1970s

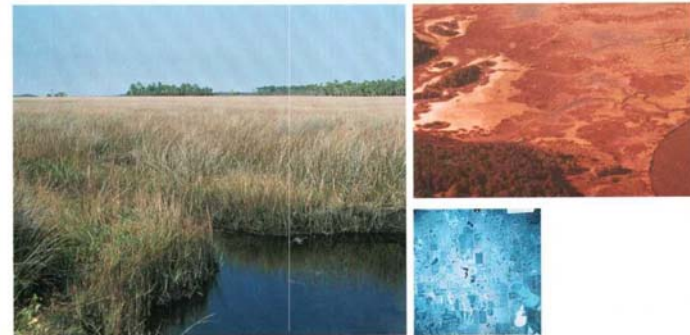


# NWI Classification

- NWI mapping uses the Cowardin et al. system
- Hierarchical system
  - Ecological System
    - Marine, Estuarine, Riverine, Lacustrine, Palustrine
  - Subsystems
  - Class
    - Emergent, Scrub-Shrub, Forested, etc.
  - Subclass
  - Modifiers – water regime, water chemistry, soil, and special

FWS/OBS-79/31  
DECEMBER 1979  
Reprinted 1992

## Classification of Wetlands and Deepwater Habitats of the United States



U.S. Department of the Interior  
Fish and Wildlife Service

---

# NWI Classification: Emphasis

- Vegetation or Substrate
  - Hydrology (Water Regime)
  - Water Chemistry (pH and halinity/salinity)
  - Human Impacts (Special Modifiers)
- 
- Purpose: Mainly to provide consistent terms for wetland classification and mapping
-

# NWI Types – originally results shown on maps (before GIS)



---

# Some Questions to Answer

How many wetlands are there – not polygons?

What is the size range of wetlands or a given type – not polygons?

How many wetlands are in various size classes?

How much and how many

- occur along rivers? along streams?  
in lake basins?
- are isolated? are sources of streams?
- have inflow but no outflow? are connected to other wetlands or waters?

What types of ponds are there and what is their extent?

What wetlands are likely to be important for certain functions?

Virtually all trends studies show increases in ponds and losses of vegetated wetlands, how does this affect functions?

---

- 
- Some questions can be answered by GIS manipulation (e.g., merging polys)
  - Others require additional classification and possibly additional linework to further divide polys as appropriate (but not done to date).
-

---

# What is the NWI classification missing?

- **FEATURES THAT CAN BE SEEN ON A TOPOGRAPHIC MAP**
  - Abiotic Properties including
    - Landscape Position
      - Is the wetland a river, stream, lake, reservoir, or pond?
      - Is it not associated with a waterbody? Perhaps completely surrounded by upland (dryland).
    - Landform
      - Is the wetland situated in a depression, on a flat, on a floodplain, or on a slope?
      - Is it in shallow water or along a waterbody in an area frequently flooded?
    - Water Flow Path
      - Where is the water coming from and going to from this wetland?
  - Mostly an issue for Palustrine Wetlands which account for 95% of the wetlands in the lower 48 states
  - **Also missing surficial geology and groundwater relations but that's beyond what can be done through aerial mapping**
-



---

# HGM Classification

- Dr. Mark Brinson developed the “hydrogeomorphic classification system” to address abiotic features that influence wetland functions
  - His main purpose was to be able to classify wetlands for developing “reference wetlands” for assessing wetland impacts and “condition” (departure from reference), and helping design appropriate mitigation
  - Unfortunately the HGM classification was not planned as an add-on to the Cowardin et al. system and in the process used some of the same terms as Cowardin (riverine and lacustrine) but defined them differently
-

---

## Basic Goal of NWI+ = Integrate Concept of HGM into NWI Mapping

- Given GIS technology ... add HGM-type descriptors to NWI types to expand classification for:
    - Better characterization of wetlands and waterbodies (especially Palustrine types)
    - Increase functionality of the NWI database for use in:
      - Predicting wetland functions at the landscape level
      - Identifying potential wetland restoration sites
  - Apply when updating NWI data
-

---

# NWI+

- Takes the basic concept of HGM and applies descriptors for landscape position, landform, water flow path, and waterbody type to NWI data to create an expanded database:

## NWI+ Database

**Note: These data are not a standard product of the NWI; they are a special product that is typically user-funded or user-produced.**

---

---

# What do NWI+ Data Include?

## ■ **Standard Data**

- ❑ Expanded wetland classification
  - Hgm-type descriptors
- ❑ Wetlands of potential significance for many functions

## ■ **Optional Data**

- ❑ Potential wetland restoration sites
  - ❑ Areas that may support wetlands based on soil mapping
-

---

# Standard NWI+ Data

- HGM-type Descriptors
    - Landscape Position
    - Landform
    - Water Flow Path
    - Waterbody Type
  - Wetlands Significant for 11 Functions
-

---

# HGM-Type Descriptors

- Landscape Position – the relationship of a wetland to a contiguous waterbody
- Landform – the physical shape of the wetland
- Water Flow Path – the directional flow of water related to the wetland
- Waterbody Type – more descriptive of lakes, ponds, estuaries, rivers, and streams

Called “**LLWW Descriptors**”.

---

# Dichotomous Keys for Classification

(since 1997; due for  
minor additions in  
2014)

**Dichotomous Keys and Mapping Codes  
for Wetland Landscape Position,  
Landform, Water Flow Path, and  
Waterbody Type Descriptors: Version 2.0**

*August 2011*



---

# Landscape Position

- Relationship between a Wetland and a Waterbody
    - ❑ MARINE
    - ❑ ESTUARINE
    - ❑ LOTIC
    - ❑ LENTIC
    - ❑ TERRENE
-



# Marine (associated with ocean)



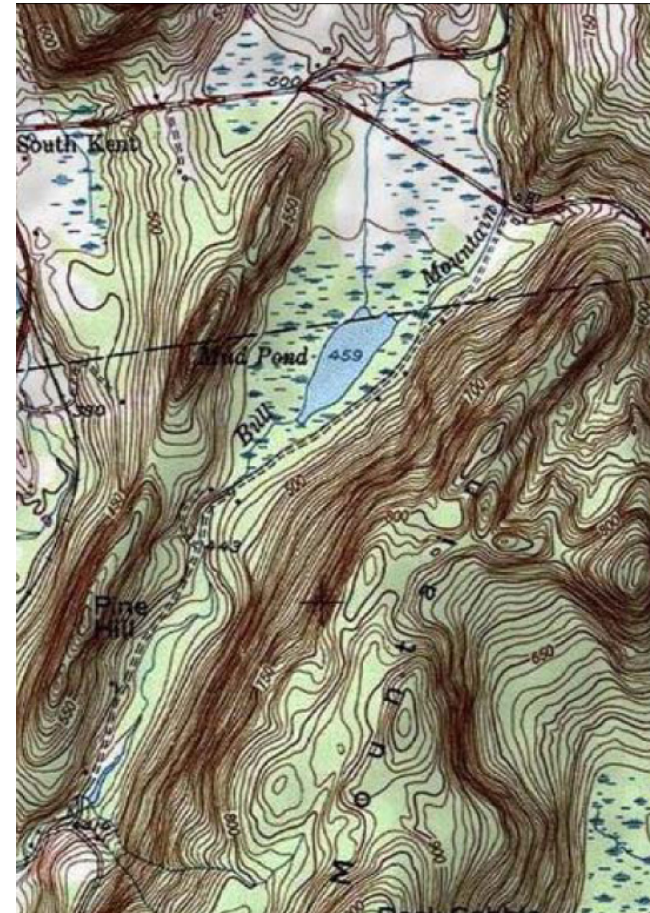
# Estuarine (associated with estuaries)





# Lentic

(associated with lakes and reservoirs)



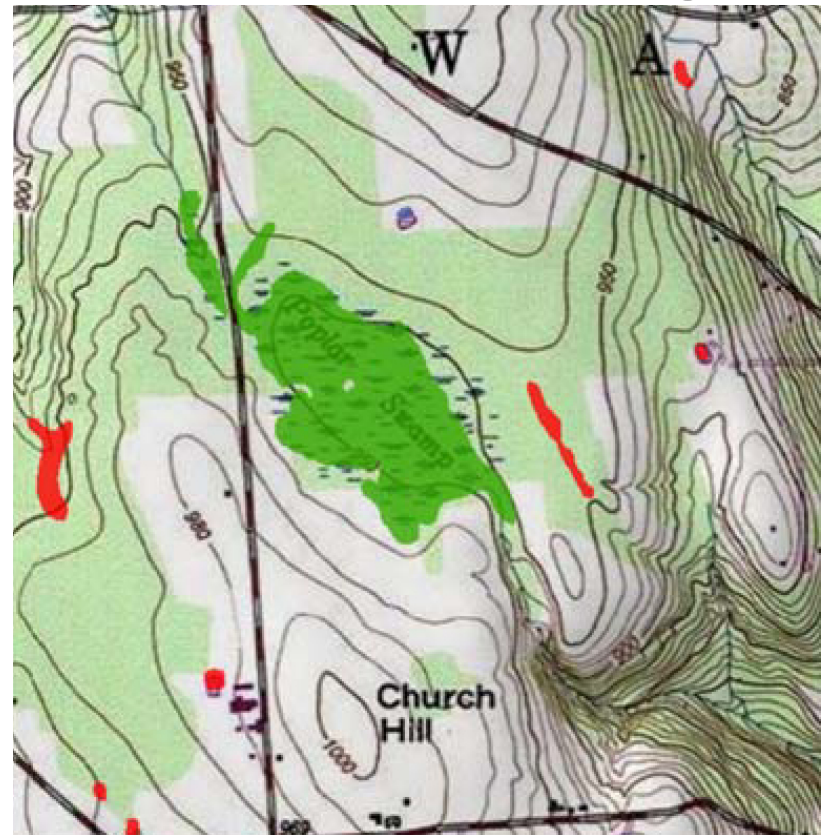


# Lotic

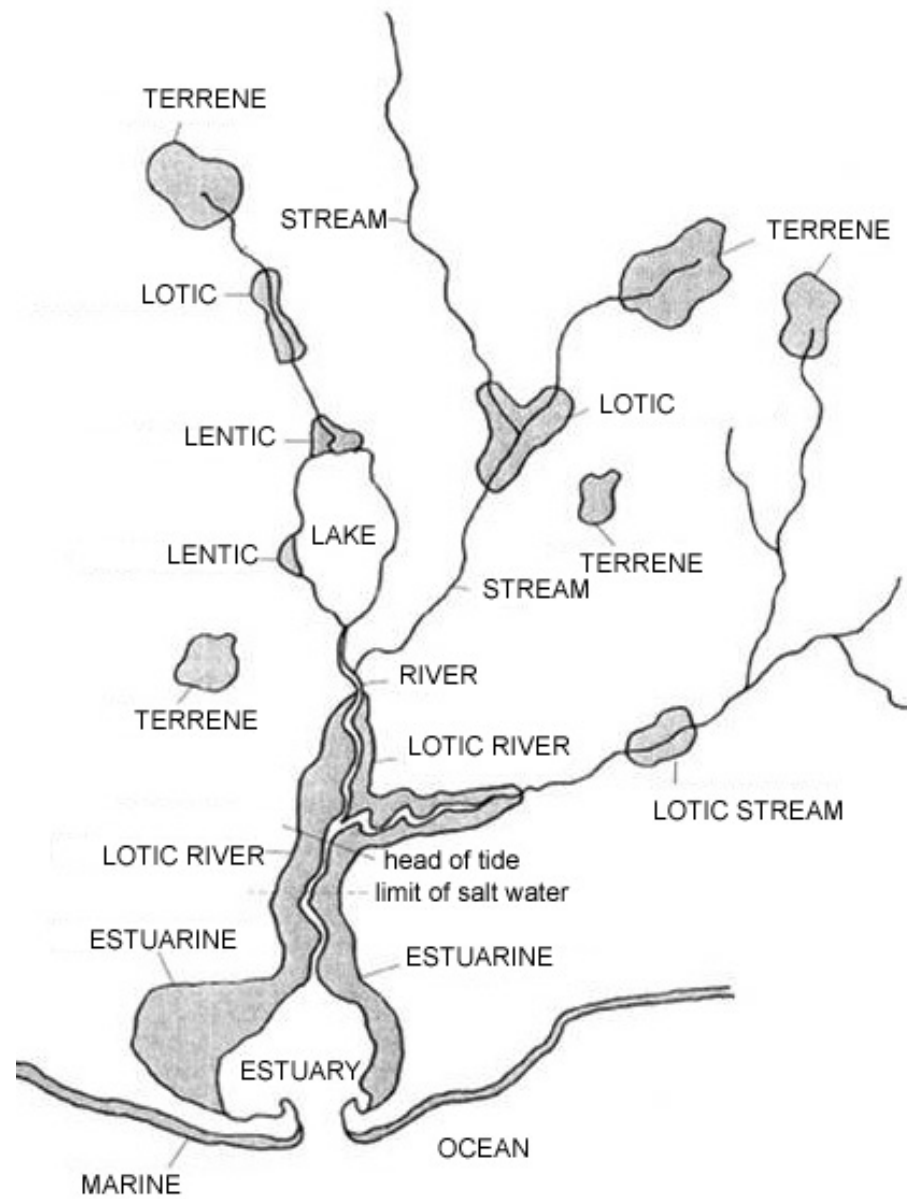
(associated with rivers and streams)



**Terrene** (isolated, source of stream, or hydrologically decoupled from stream; latter types often are groundwater discharge sites)







---

# Landforms

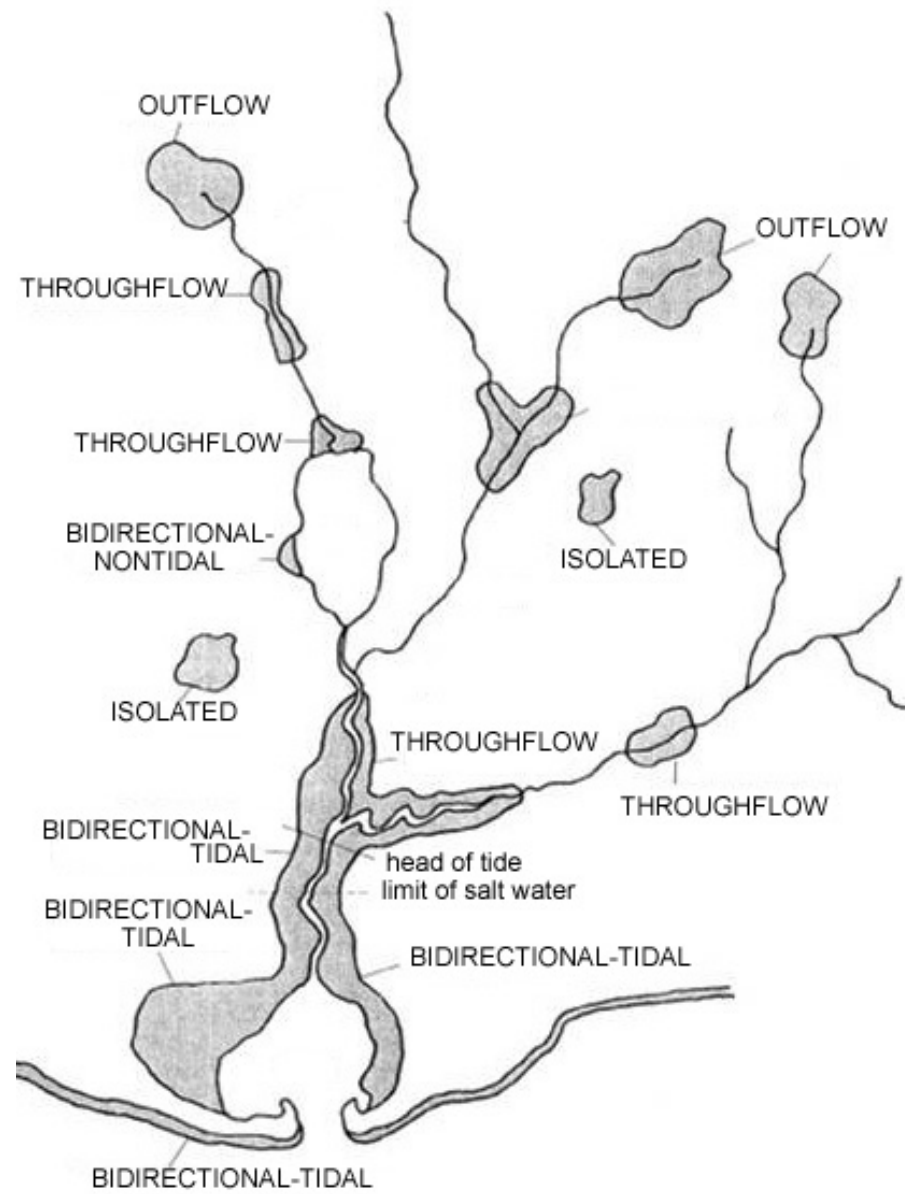
- Slope (>2%)
  - Island (coastal - e.g., delta, river, bay)
  - Fringe (coastal – e.g., barrier island, bay, bay island; inland – pond, lentic, lotic)
  - Floodplain (basin, flat, island)
  - Basin
  - Flat
-

---

# Water Flow Path

- **Bidirectional Tidal** (artificial)
  - **Bidirectional Nontidal** (artificial)
  - **Throughflow** (perennial, intermittent, entrenched, artificial)
  - **Outflow** (perennial, intermittent, artificial)
  - **Inflow**
  - **Isolated** (other descriptors to show any connectivity between isolated types in “isolated complex”)
  - **Paludified**
-





---

# Waterbody Types

- More specific types:
  - Estuary: Drowned River Valley, Bar-built;
    - Macrotidal, Mesotidal (6-12 ft tides), Microtidal
    - Circulation patterns – salt-wedge, homogenous, partially mixed
  - Rivers/Streams: gradients, dammed
  - Lakes: natural, dammed (reservoir)
  - Ponds: natural (woodland-wetland, woodland-dryland, sinkhole-woodland, sinkhole-prairie, Carolina bay, cypress dome, vernal-woodland, interdunal, floodplain, grady, other), dammed/impounded (aquaculture, agriculture, industrial, golf, stormwater, etc.), excavated (etc.), beaver
    - Note: Can add other types of interest – list is a first cut.
-

---

## Other Descriptors - Examples

- Headwater\*
- Floating mat
- Drainage divide
- Partly drained
- Coastal island
- Freshwater wetland discharging directly into an estuary\*
- Overwash
- Tidally restricted (road or railroad)\*
- Fragmented

\*Applied for all projects

---

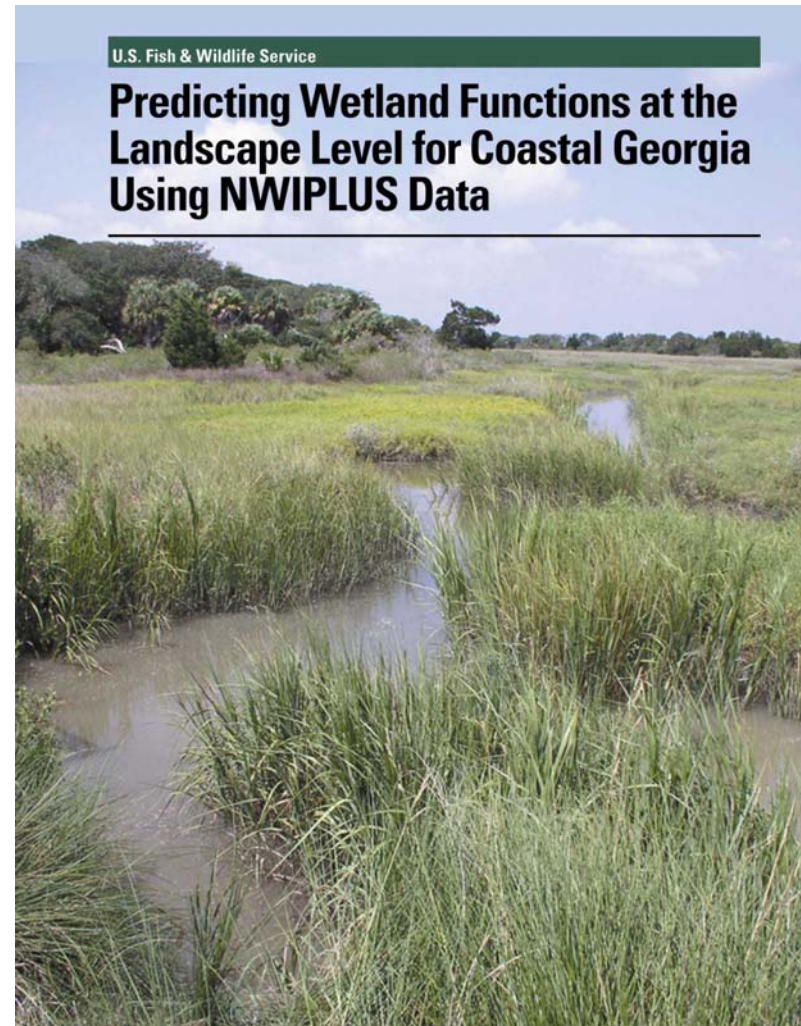
---

# NWI+ for Functional Assessment

- Landscape-level Assessment
  - Preliminary
    - Based on existing geospatial data
  - Apply to watershed, coastal zone, county, or entire state
  - Correlate descriptors in NWI+ database with wetland functions
-

# Coordinated Effort To Develop Correlations

- Reviewed literature
- Worked with wetland specialists in the Northeast
  - Maine Wetland Advisory Group
  - NYCDEP
  - Nanticoke Wetlands Study Group
  - FWS biologists
  - Others
- Correlation Report (2003) and Tables (2013)
- Should review prior to use in other geographic regions
  - Reviewed/revised for coastal **Georgia**, Wisconsin, and New Mexico
- User Adaptable (can modify functions of interest)



---

# Preliminary Functional Assessment

- Surface Water Detention (inland wetlands)
  - Coastal Storm Surge Detention
  - Streamflow Maintenance
  - Bank and Shoreline Stabilization
  - Nutrient Transformation
  - Carbon Sequestration
  - Sediment and Other Particulate Retention
  - Provision of Fish and Wildlife Habitat
    - Fish and Aquatic Invertebrates
    - Waterfowl and Waterbirds
    - Other Wildlife
  - Provision of Habitat for Unique, Uncommon, or Highly Diverse Wetland Plant Communities (formerly Conservation of Biodiversity; *based on mapped types not through field surveys*)
-

---

# Developing Functional Correlations

- Correlate Functions with Characteristics
    - Some emphasize LLWW descriptors
      - Surface Water Detention
      - Streamflow Maintenance
    - Some only use general wetland type/water regime
      - Nutrient Transformation
      - Habitat for Other Wildlife
    - Others rely on general wetland type/water regime + LLWW
      - Bank and Shoreline Stabilization
      - Sediment Retention
      - Habitat for Fish and Aquatic Invertebrates
      - Habitat for Waterfowl and Waterbirds
      - Habitat for Unique, Uncommon, or Highly Diverse Wetland Plant Communities
-

---

# Limitations of Landscape-level Assessment

- First approximation
  - Source data limitations
    - All wetlands not shown
    - Possible upland inclusions
    - All streams not shown
    - Age of data (not an issue if done with updated data!)
  - Enhanced wetland classifications based largely on photo and map interpretation plus merging with other databases (e.g., streams)
  - Correlations between functions and characteristics = adaptable to different regions and user interests
-



---

## Examples of Watershed Reports Using NWI+ Database

- Assessment of Hackensack River Watershed Wetlands
  - Historic Assessment of Wetlands in the Nanticoke Watershed
-

# Hackensack River Watershed – Characterization and Functional Assessment

By Ralph W. Tiner  
and Herbert C. Bergquist  
National Wetlands Inventory  
Program  
Ecological Services  
U.S. Fish and Wildlife Service  
Northeast Region  
300 Westgate Center Drive  
Hadley, MA 01035

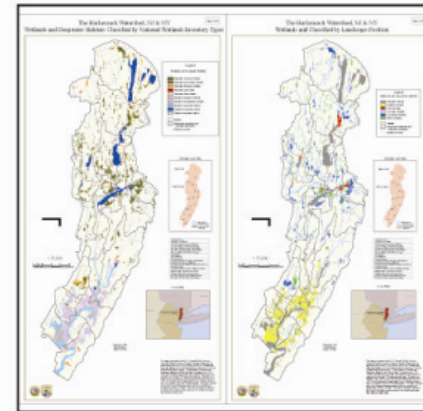
Produced by the U.S. Fish and  
Wildlife Service  
National Wetlands Inventory  
Program  
Ecological Services,  
Northeast Region  
Hadley, MA

September 2007

U.S. Fish & Wildlife Service

## The Hackensack River Watershed, New Jersey/ New York:

*Wetland Characterization,  
Preliminary Assessment of  
Wetland Functions, and Remotely-  
sensed Assessment of  
Natural Habitat Integrity*



## Table of Contents

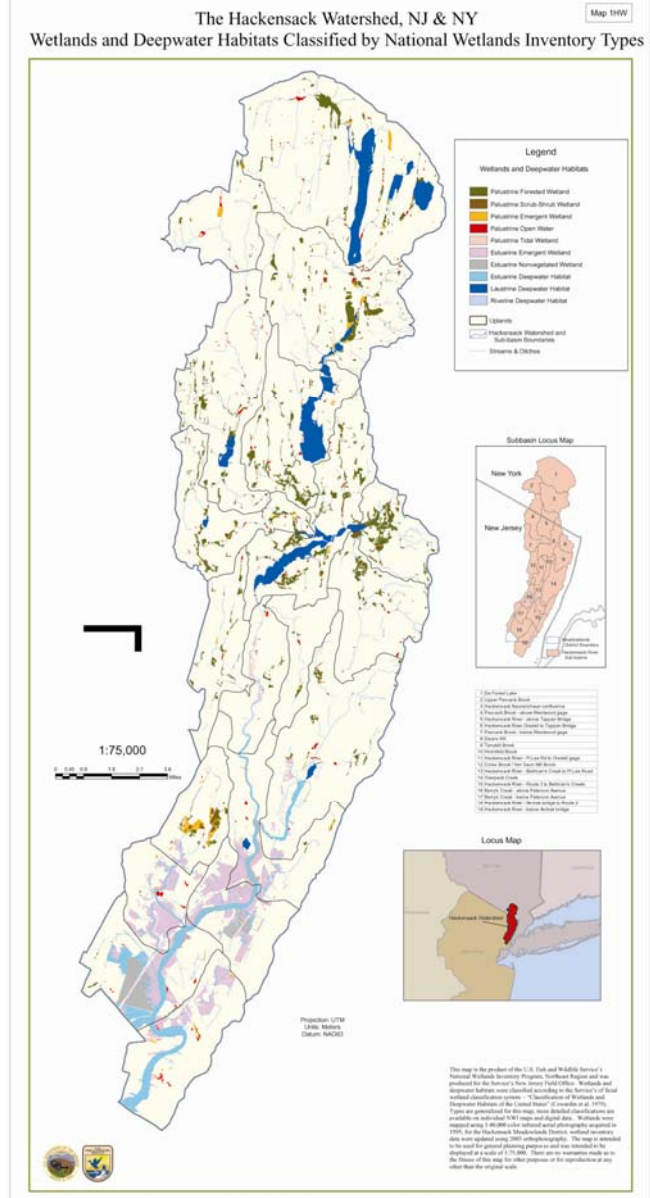
	Page
Introduction	1
Study Area	2
Methods	5
Classification and Characterization	5
GIS Analysis and Data Compilation	7
Preliminary Functional Assessment	8
General Scope and Limitations of Preliminary Wetland Functional Assessment	8
Rationale for Preliminary Wetland Functional Assessment	9
Natural Habitat Integrity Assessment	15
Appropriate Use of this Report	22
Results	23
Maps	23
Watershed Findings	23
Wetland Characterization	23
Preliminary Assessment of Wetland Functions	27
Remotely-sensed Indices of “Natural Habitat Integrity”	30
Subbasin Findings	32
Wetland Characterization	32
Preliminary Assessment of Wetland Functions	35
Remotely-sensed Indices of “Natural Habitat Integrity”	35
Conclusions	39
Acknowledgments	41
References	42
Appendices	45
A. Coding for LLWW descriptors from “Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors.”	46
B. Study findings for individual subbasins.	57
Berry’s Creek above Paterson Avenue	58
Berry’s Creek below Paterson Avenue	62
Coles Brook-Van Saun Mill Brook	66
De Forest Lake	70
Dwars Kill	75
Hackensack River – Amtrak bridge to Route 3	79
Hackensack River above Tappan Bridge	83
Hackensack River – Bellman’s Creek to Ft. Lee Road	87
Hackensack River below Amtrak bridge	91
Hackensack River – Fort Lee Road to Oradell gage	95

---

# Watershed-Wetland Stats

- 9,650 acres
  - 42% estuarine emergent
  - 33% palustrine forested
  - 13% estuarine unconsolidated shore
  - 25% lotic
  - 5% lentic
  - 11% terrene
  - 4% ponds
  - 61% tidal
  - 25% throughflow
  - 7% outflow
  - 5% isolated
  - 2% bidirectional-nontidal
-

# Thematic Maps: NWI Types



The Hackensack Wetlands and Classified by Landscape Position

Map 20

Legend

Wetlands and Deepwater Habitats

- Deepwater Habitats
- Estuarine Wetlands
- Lentic Wetlands
- Lotic River Wetlands
- Lake River Wetlands
- Terrestrial Wetlands
- Uplands
- Hackensack Watershed and Sub-Aquatic Habitats
- Streams & Ditches

Subbasin Locust Map

New York

New Jersey

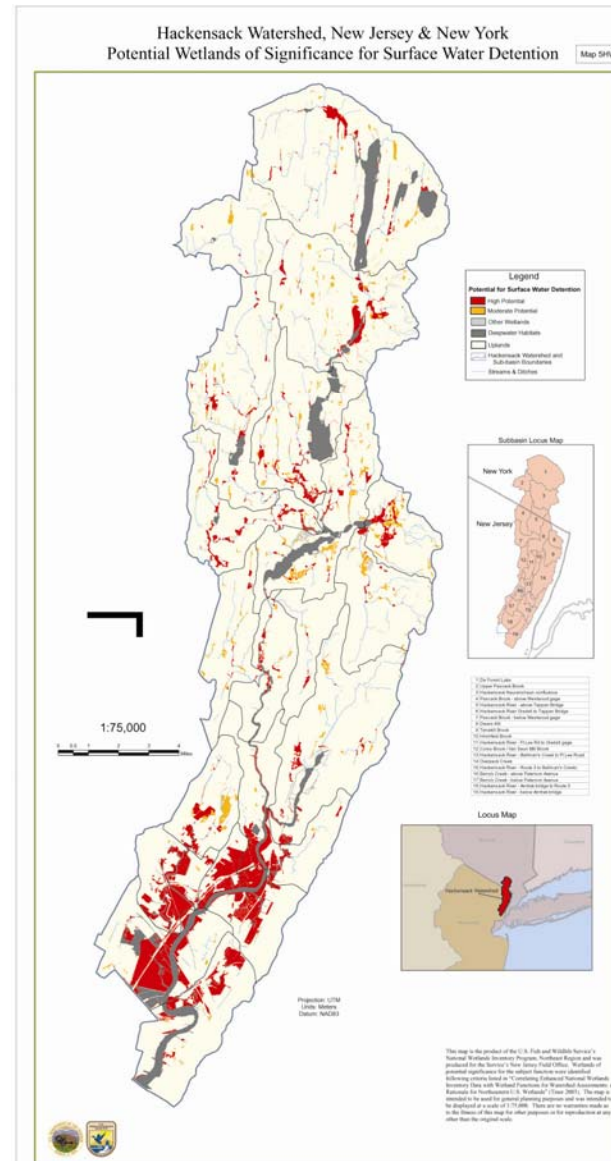
Locust Map

1:75,000

Projection: UTM  
Datum: NAD83

This map is the product of the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) project and was prepared for the Bureau's New Jersey Field Office. Wetlands and Deepwater Habitats were classified according to the Bureau's official wetland classification system, "Classification of Wetlands and Deepwater Habitats of the United States" (Cowardin et al., 1979). Types are generalized to the map; more detailed classification are available on individual NWI maps and digital data. Wetlands were mapped using 1:62,500 scale infrared aerial photography acquired in 1991 for the Hackensack Subbasin. Wetlands, riparian resources, and other aquatic resources were mapped. The map is intended to be used for general planning purposes and was intended to be developed at a scale of 1:75,000. There are no warranty made as to the fitness of this map for other purposes or for reproduction in any other form than the original scale.

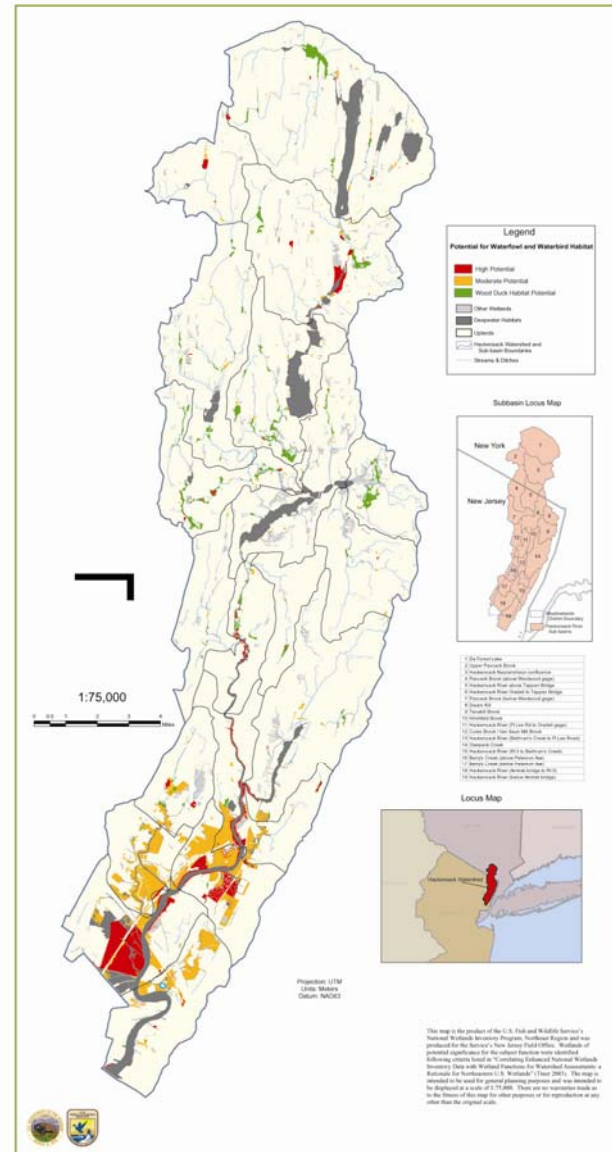
# Wetland Function: Surface Water Detention



# Waterfowl & Waterbird Habitat

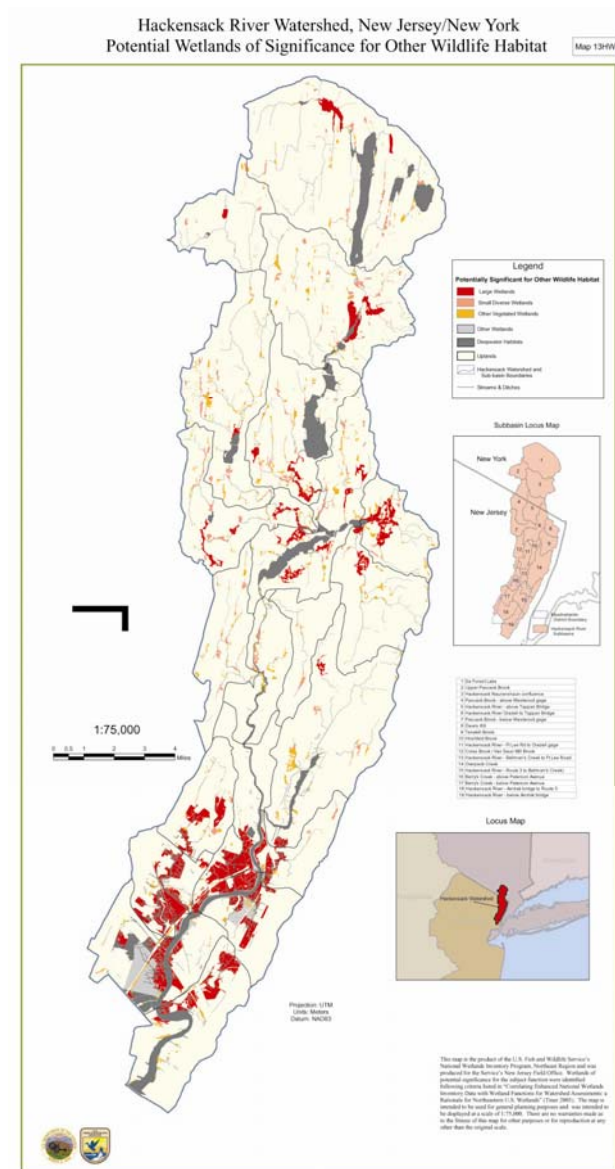
Hackensack River Watershed, New Jersey/New York  
Potential Wetlands of Significance for Waterfowl and Waterbird Habitat

Map 12H6W

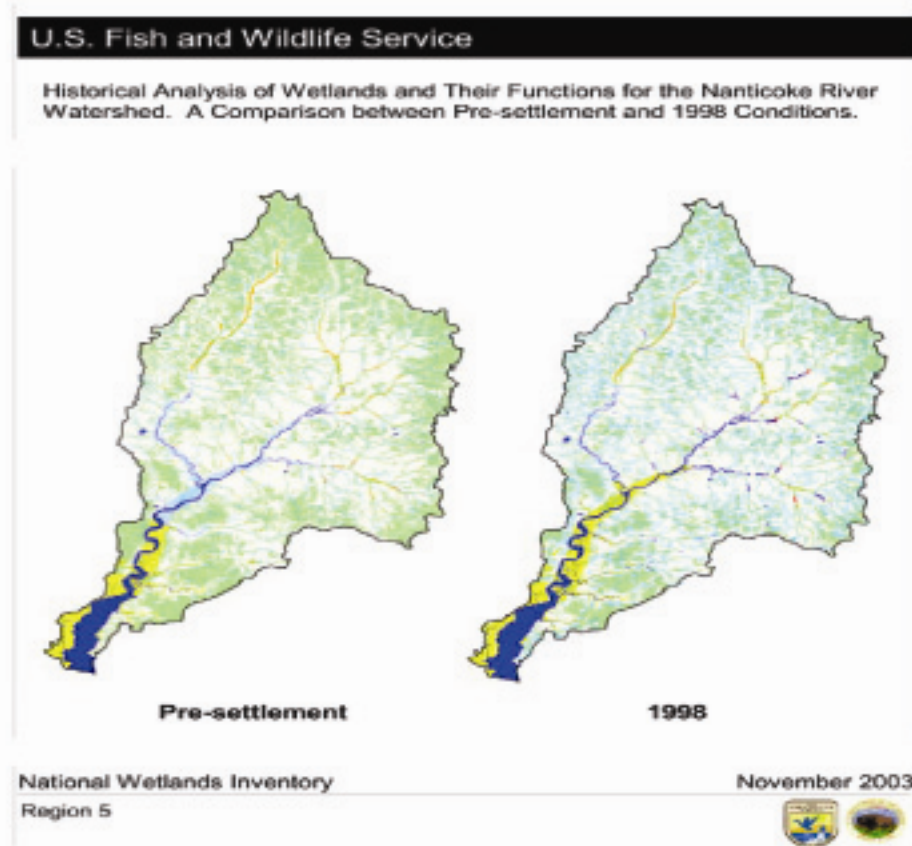




# Other Wildlife Habitat



# Assessing the Impact of Wetland Changes: Historic Changes for Nanticoke Watershed



---

# Nanticoke Wetland Stats

## Pre-settlement

- 230,000 acres
- 2,814 wetlands
- 72% outflow wetlands
  - Average size = 433 acres

## 1998

- 142,000 acres (62% of pre-settlement acreage)
  - 5,810 wetlands
  - 43% decrease in outflow wetlands
    - Average size = 44 acres
  - Palustrine wetlands – lost 40%
  - Estuarine wetlands – lost 28%
-

---

## Wetland Functions Watershed-wide (1998)

- >95% for surface water detention and sediment/other particulate retention
  - 84% nutrient transformation
  - 83% other wildlife habitat
  - 79% fish and shellfish habitat
  - 71% waterfowl-waterbird habitat
  - 70% shoreline stabilization
  - 58% coastal storm surge detention
  - 30% streamflow maintenance
-

---

## Impact of Wetland Changes on Functions *(Pre-settlement to 1998)*

- Surface Water Detention = -36%
  - Streamflow Maintenance = -64%
  - Nutrient Transformation = -47%
  - Sediment Retention = -46%
  - Coastal Storm Surge Detention = -23%
  - Fish-Shellfish Habitat = -33%
  - Waterfowl-Waterbird Habitat = -34%
  - Other Wildlife Habitat = -41%
-

---

# Summary of Uses of NWI+

## ■ Better characterization of wetlands

- Can use for descriptions of wetland types in the area of interest and as aid in selecting sites for monitoring and research
  - NWI+ doesn't address all the reasons behind unique wetland characteristics (e.g., water chemistry differences due to surficial geology and groundwater connections; Azzolina et al. 2007) but there are provisions through Cowardin et al. and LLWW to include water chemistry (pH, salinity) and groundwater interactions in the classification of individual wetlands
-



---

## ■ **Landscape-level Assessment of Wetland Functions**

### □ Preliminary

- Current capacity of “area of interest” to provide functions

### □ Can use to assess possible effect of cumulative losses on wetland functions since “settlement”

### □ Can use to assess significance of wetland changes on wetland functions between time periods

- Increase in some types while other types decline will alter performance of certain wetland functions

- When applied to **potential wetland restoration sites** (former hydric soils with restoration potential), provides perspective on likely functions to be improved
-

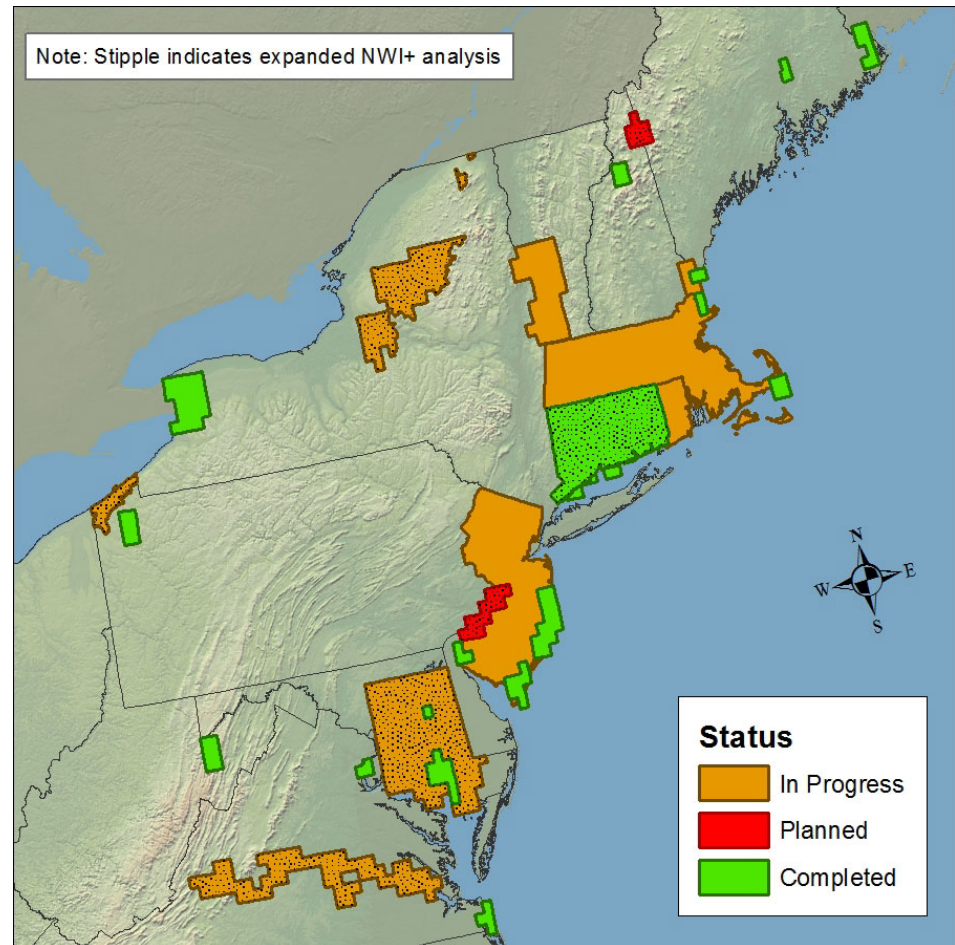
---

# Applications of NWI+ To Date

---

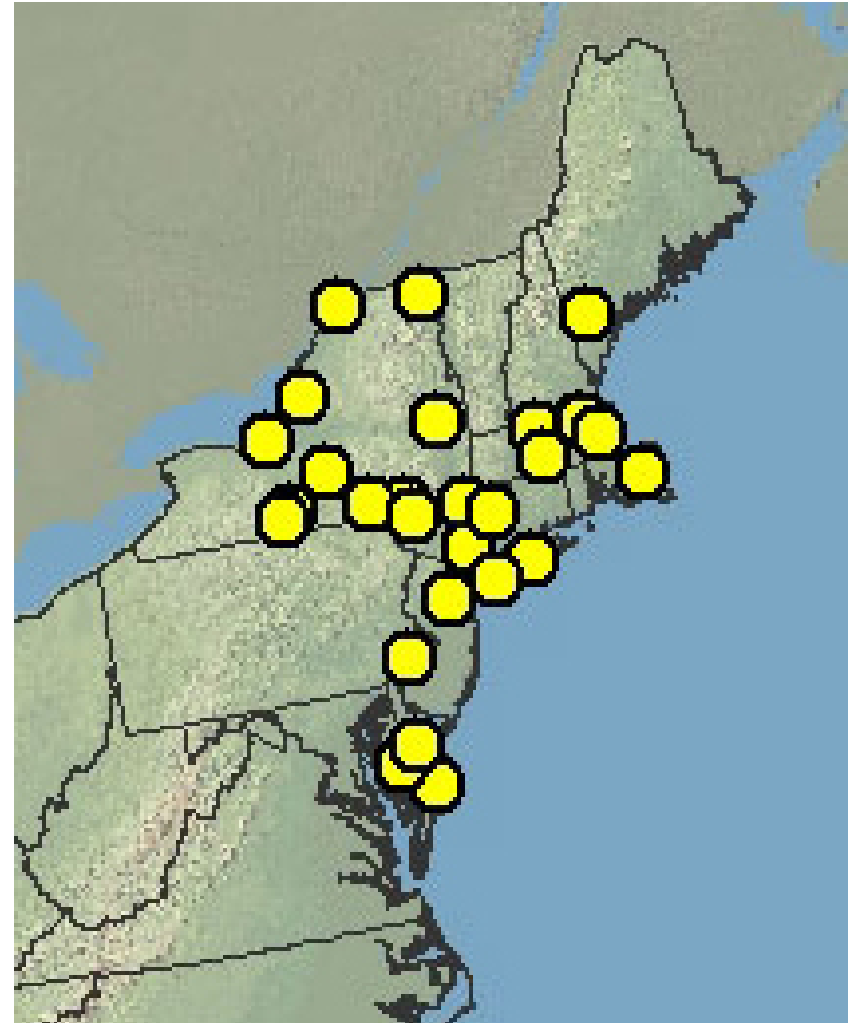
# Status of NWI+ in the Northeast

- Approximately 1000 USGS quads done to date
- Virginia Tech's Conservation Management Institute
  - Key partner in the process
- Working with us for about a decade
- Speckled areas – maximum NWI+ data



# NWI+ Reports

- ❑ 3 Massachusetts watersheds
- ❑ Casco Bay watershed, ME (~21 quads; ME State Planning Office)
- ❑ Nanticoke watershed, MD/DE (~20 quads; state funded)
- ❑ Coastal Bays watershed, MD (~5 quads; state funded)
- ❑ Delaware Estuary Coastal Zone of PA (11 quads; state funded)
- ❑ 12 small watersheds in NY State (~50 quads; NYSDEC funded)
- ❑ New York City water supply reservoirs (~65 quads; NYCDEP funded)
- ❑ Hackensack River watershed (~7 quads; field office funded)
- ❑ Cape Cod and the Islands, MA (~12 quads; completed)
- ❑ Boston Harbor Islands (7 quads; NPS funded)
- ❑ Long Island, NY (~47 quads)



---

## NWI+ Pilot Applications in Other Regions

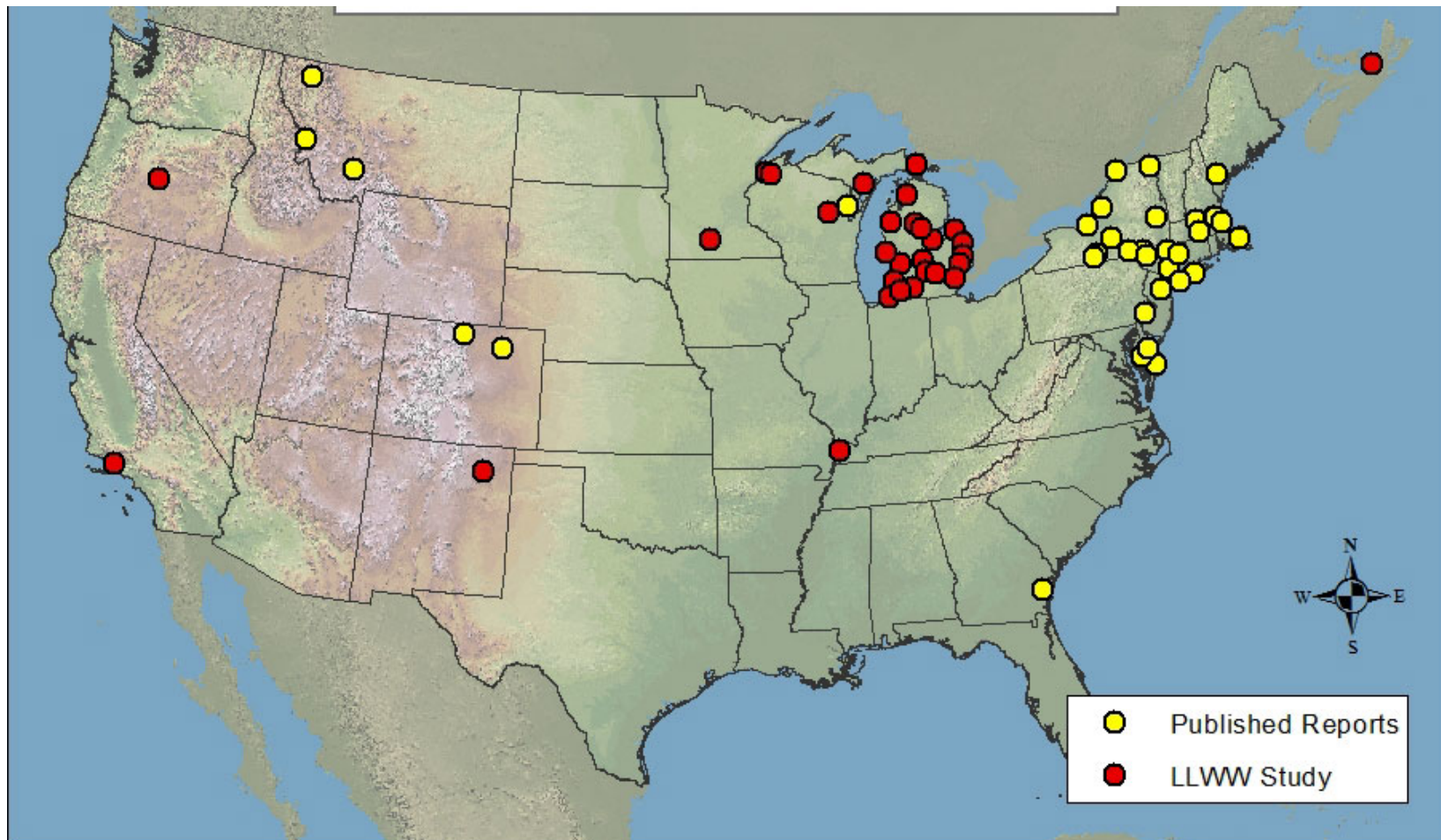
- Region 1: Ventura watershed, CA (~4 quads; project completed except for report)
- Region 2: Corpus Christi, TX (7 quads; initial classification done, QC done, finalizing)
- Region 3: Redwood River Basin, MN (2 quads; classification done)
- Region 4: Horry (26 quads) and Jasper (28 quads) counties, SC; coastal Mississippi (37 quads)
- Region 6: Shirley Basin, WY (5 quads; classification done)
- Region 7: Matanuska-Susitna Borough (4 quads; classification completed)

**Results posted online as “First Approximations”**

**Will be preparing area-based functional assessment reports as time permits (geospatial data posted on the “NWI+ Web Mapper”)**

---

# NWI+ By Others and Reports





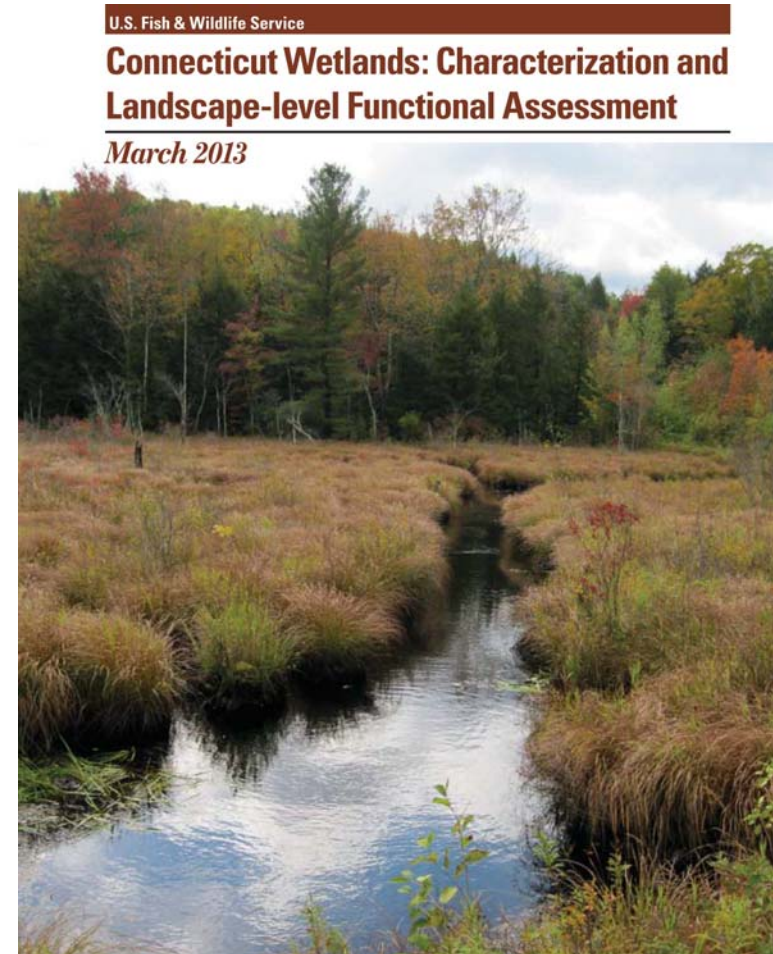
---

## Some Noteworthy Projects By Others or By FWS with Funding from Other Agencies

---

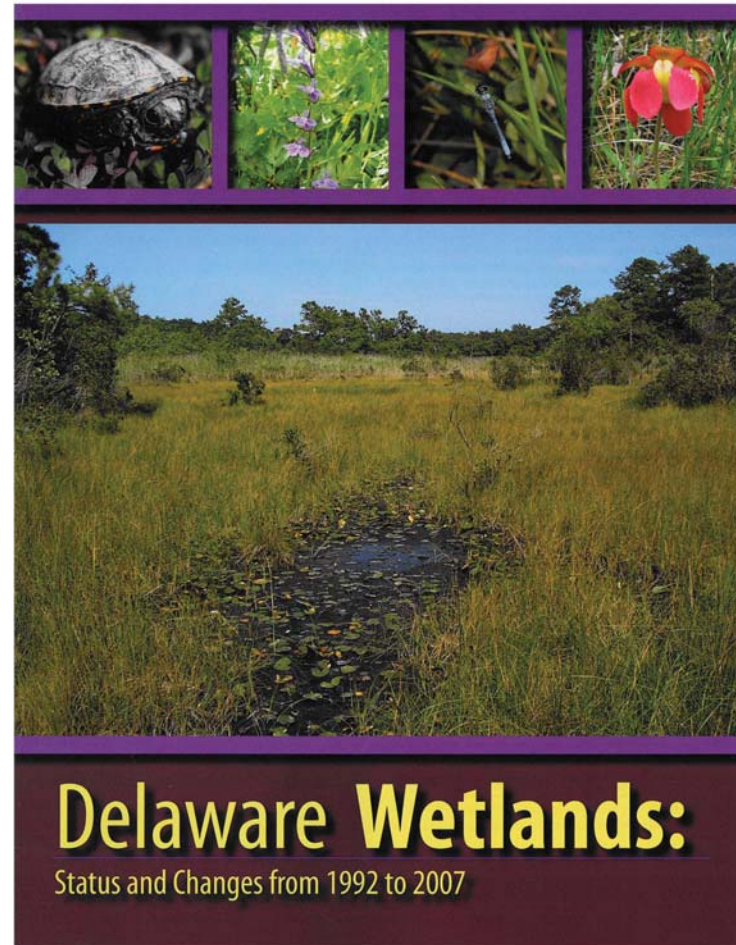
# Connecticut – Statewide Assessment

- Statewide NWI+ Database (4872 sq. mi.)
- Four reports
  - Status
  - Characterization/Functional Assessment
  - Restoration Site Inventory
  - Trends
- Funded by CTDEEP



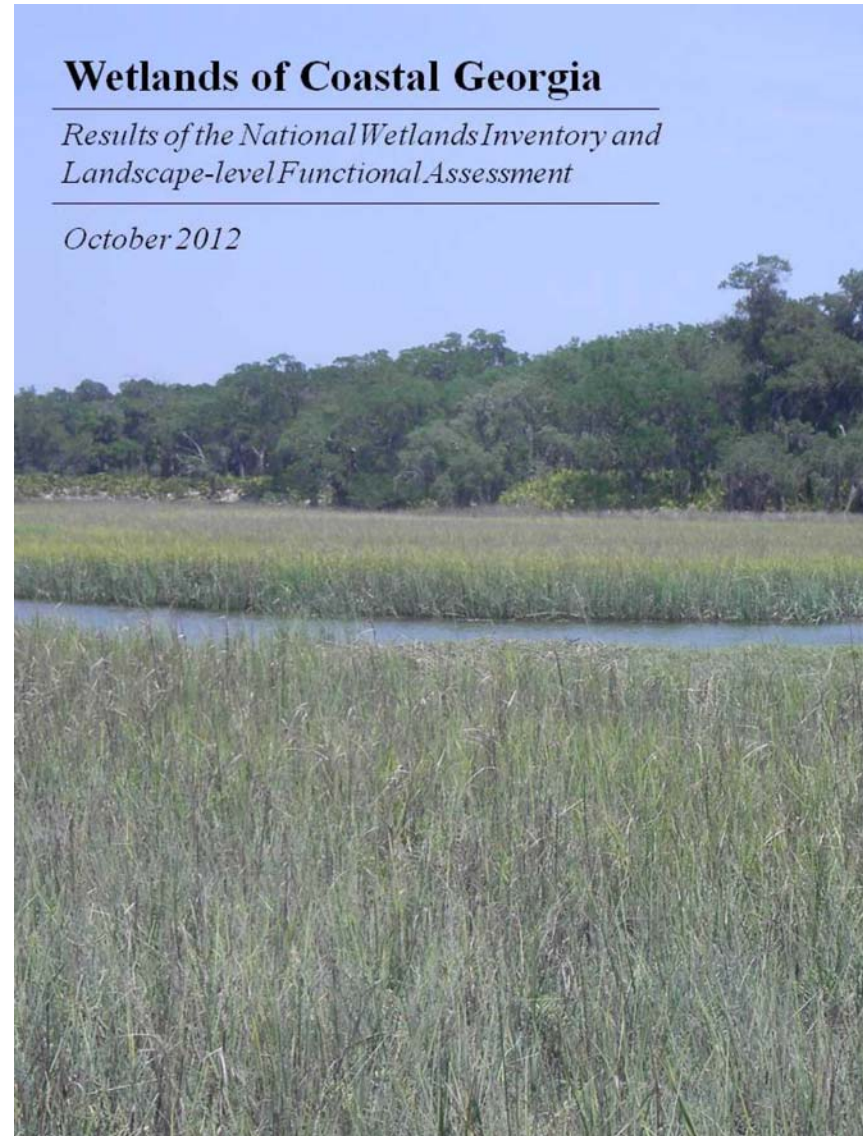
# Delaware – Statewide Assessment

- Statewide Database (1932 sq. mi.)
  - NWI
  - LLWW
  - P-wet areas
  - Restoration Site Inventory
  - Trends
- Single Summary Report
- Partially funded by DNREC



# Georgia - Coast

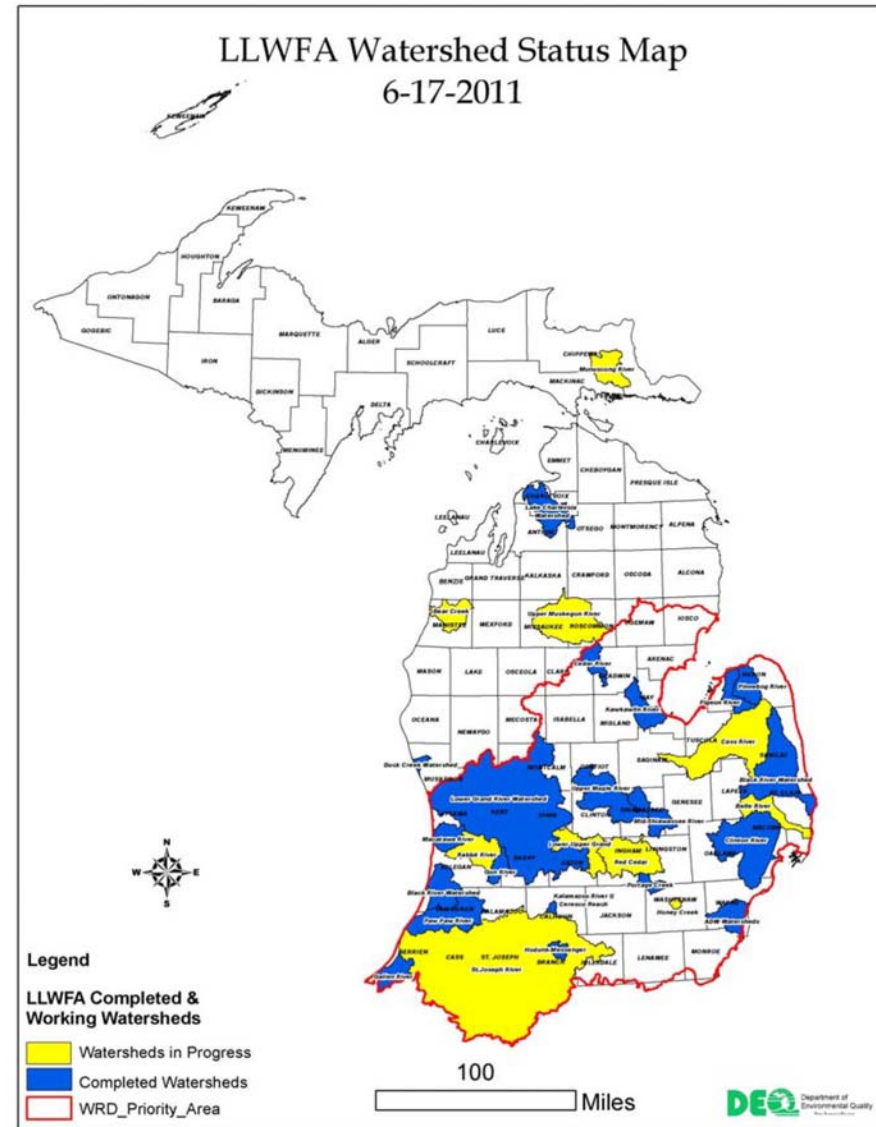
- Georgia – coastal counties (3150 sq. mi.)
- GADNR-CRD/Atkins
- Coastal County Database
  - NWI
  - LLWW
  - Functional Assessment
- Report





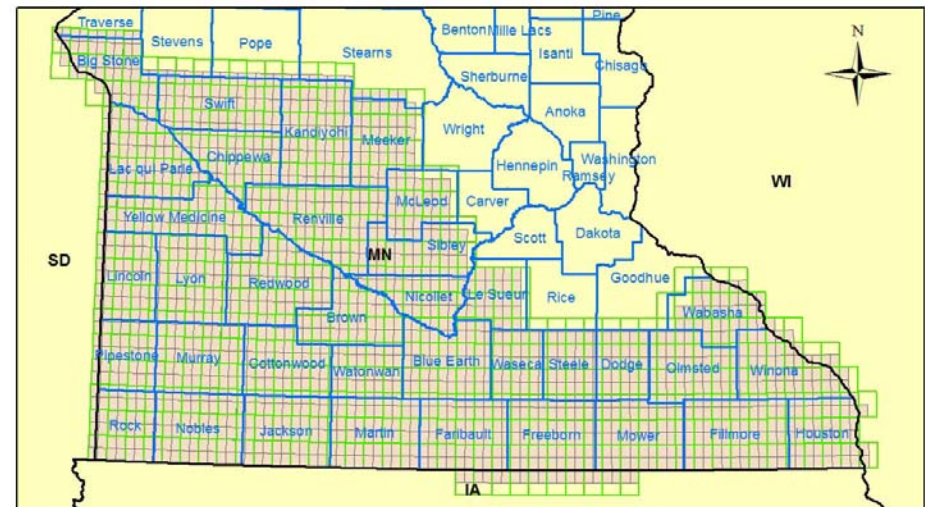
# Michigan

- MIDEQ working with watershed associations
- Many watersheds completed or in progress
- 2011 progress report



# Minnesota

- Plan to do entire state as funding permits
- Work by St. Mary's University of MN
- Southern MN counties underway
- **Note: SMUMn is working on ~1200 quads in 6 states (MN, WI, IL, MO, NM, CO)**





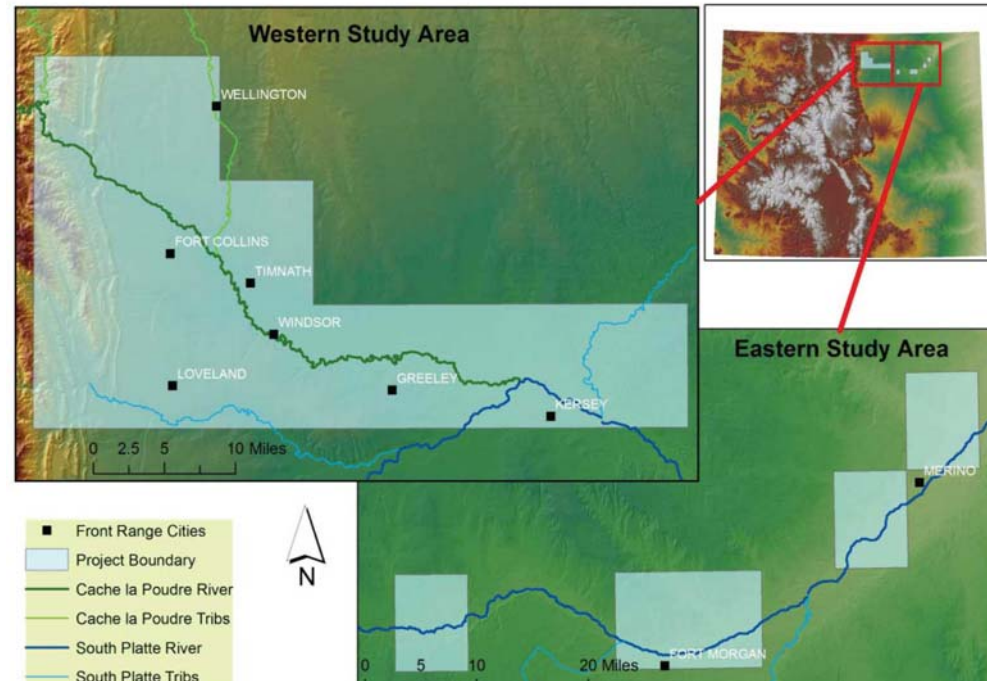
---

# Montana

- Developing a semi-automated procedure for applying LLWW to many watersheds
  - Prior work in a few watersheds:
    - Flathead Valley
    - Bitterroot Valley
    - Gallatin Valley
-

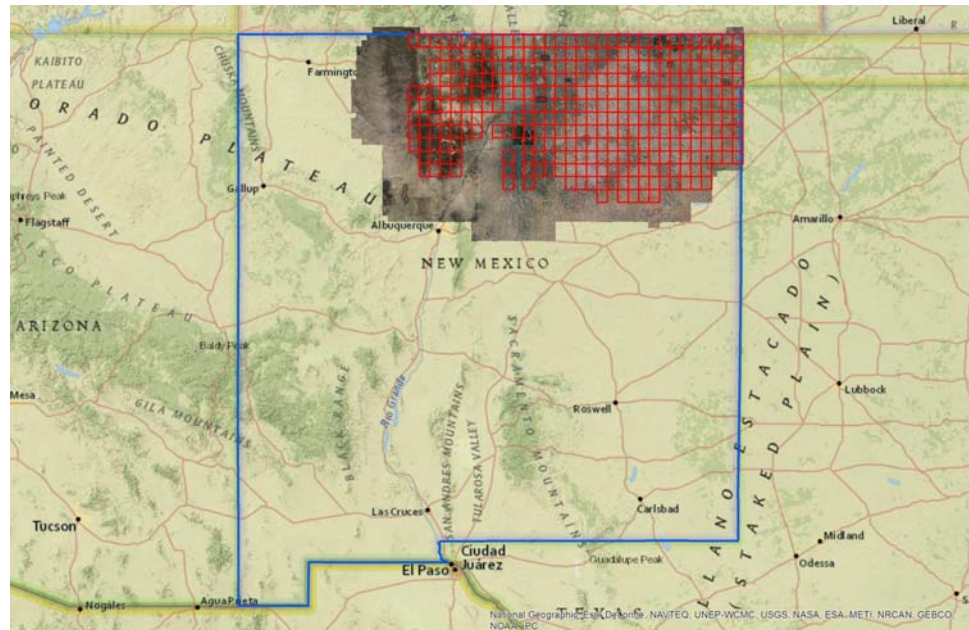
# Colorado

- CO NHP
- Two watersheds
  - Cache la Poudre
  - South Platte



# New Mexico

- NM Environment Dept. Surface Water Quality Bureau
- Incorporating LLWW into NWI Updates
- Work by SMUMn
- Northeastern NM underway



---

# Oregon – Statewide Assessment

- Portland State University and Oregon Dept. of State Lands
  - Student thesis (Matthew Paroulek)
  - Automated GIS-derived classification of LLWW from existing NWI and landscape-level (level 1) assessment
  - Statewide coverage
  - Used to help identify sample frame for Level 2 (rapid) wetland functional assessment with statewide wetland monitoring program
-

---

# NWI+ Data and Reports

## By FWS Posted Online

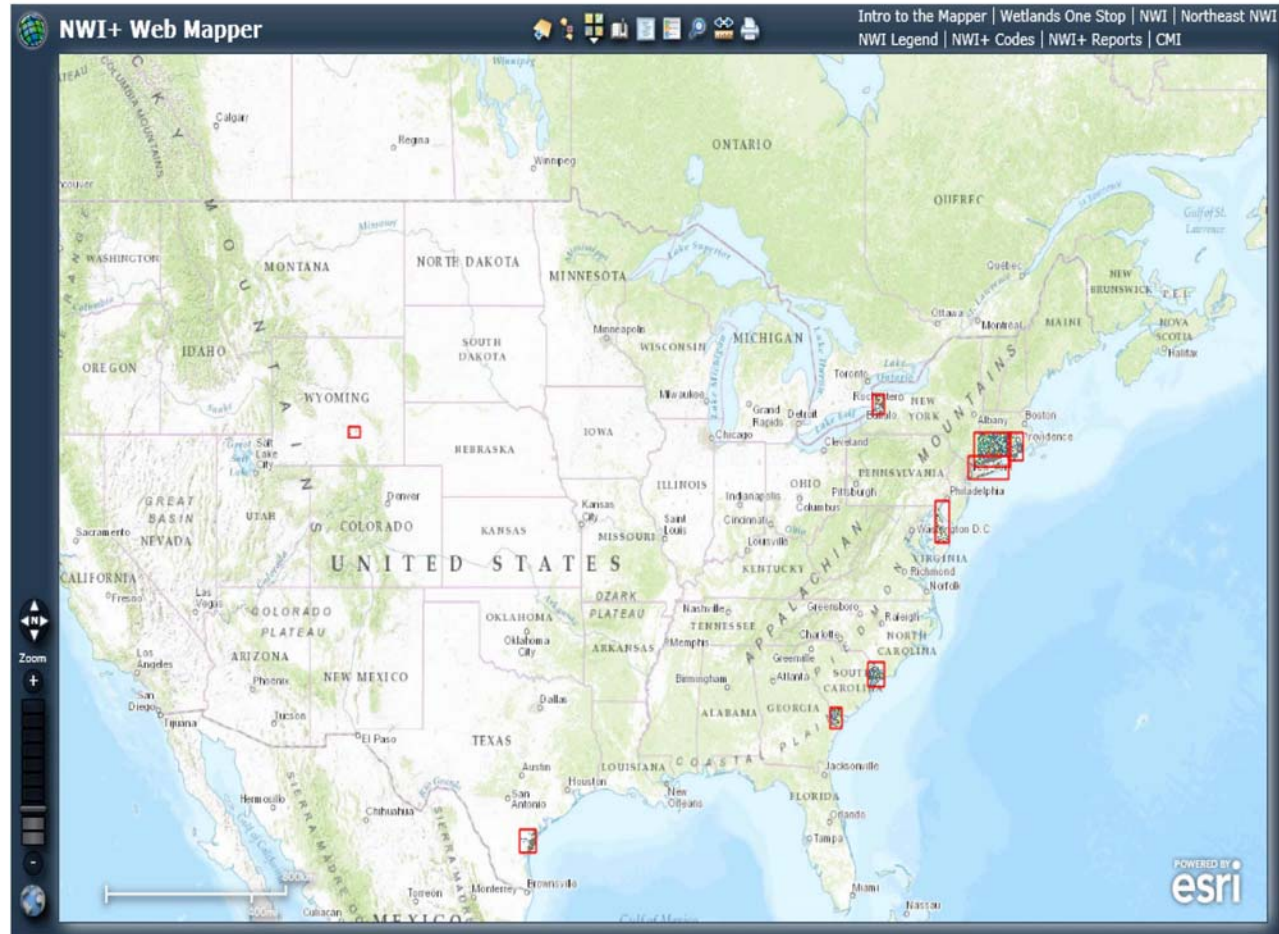
- ASWM's Wetlands One-Stop Mapping
  - <http://aswm.org/wetland-science/wetlands-one-stop-mapping>
  - Look under the topics
    - ❑ NWI+ Mapper for display of results
    - ❑ NWI+ Reports for copies of summary reports
-

# NWI+ Mapper - Views

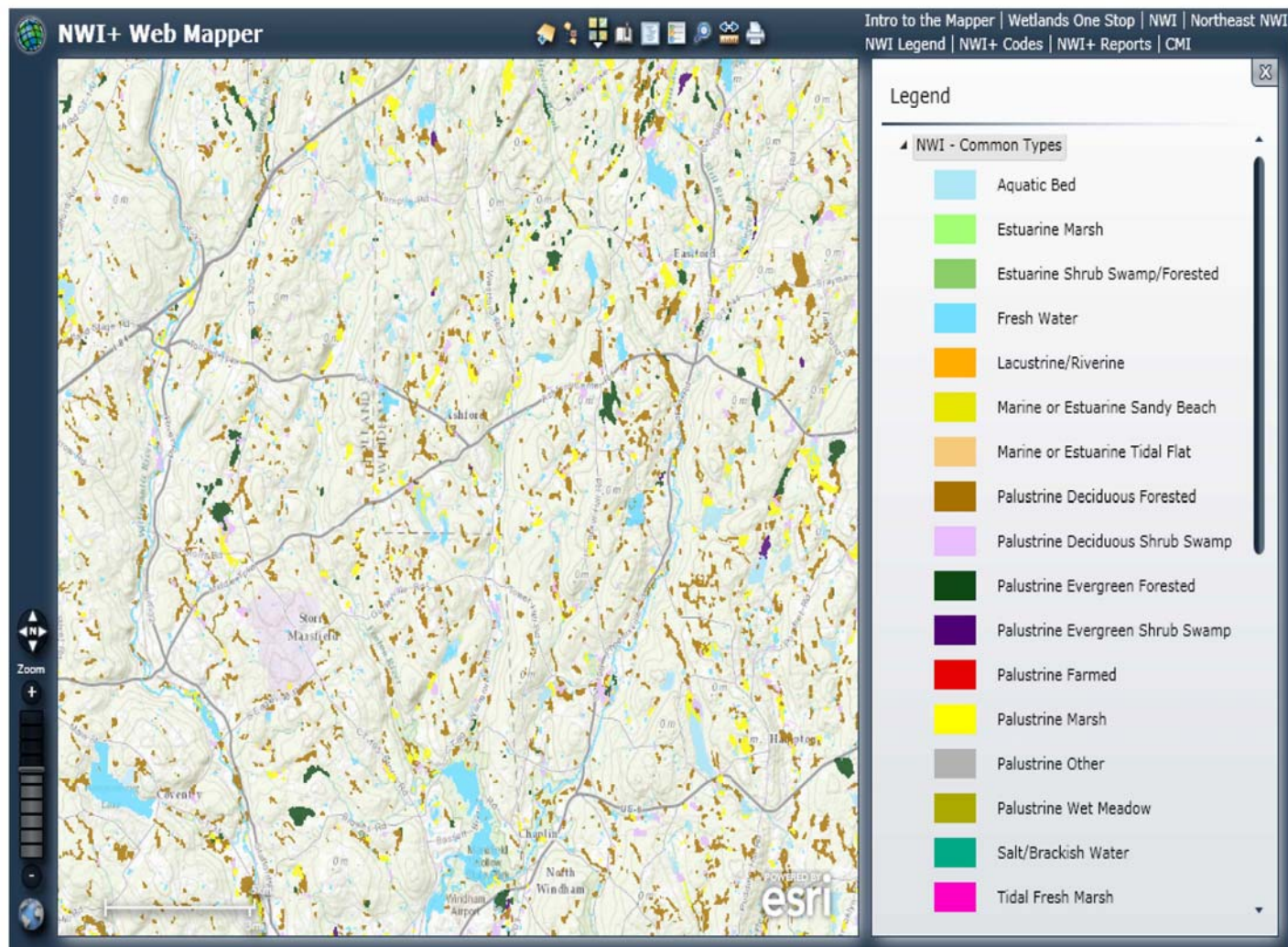
## Connecticut Examples



# Opening Page shows Footprints of FWS Projects

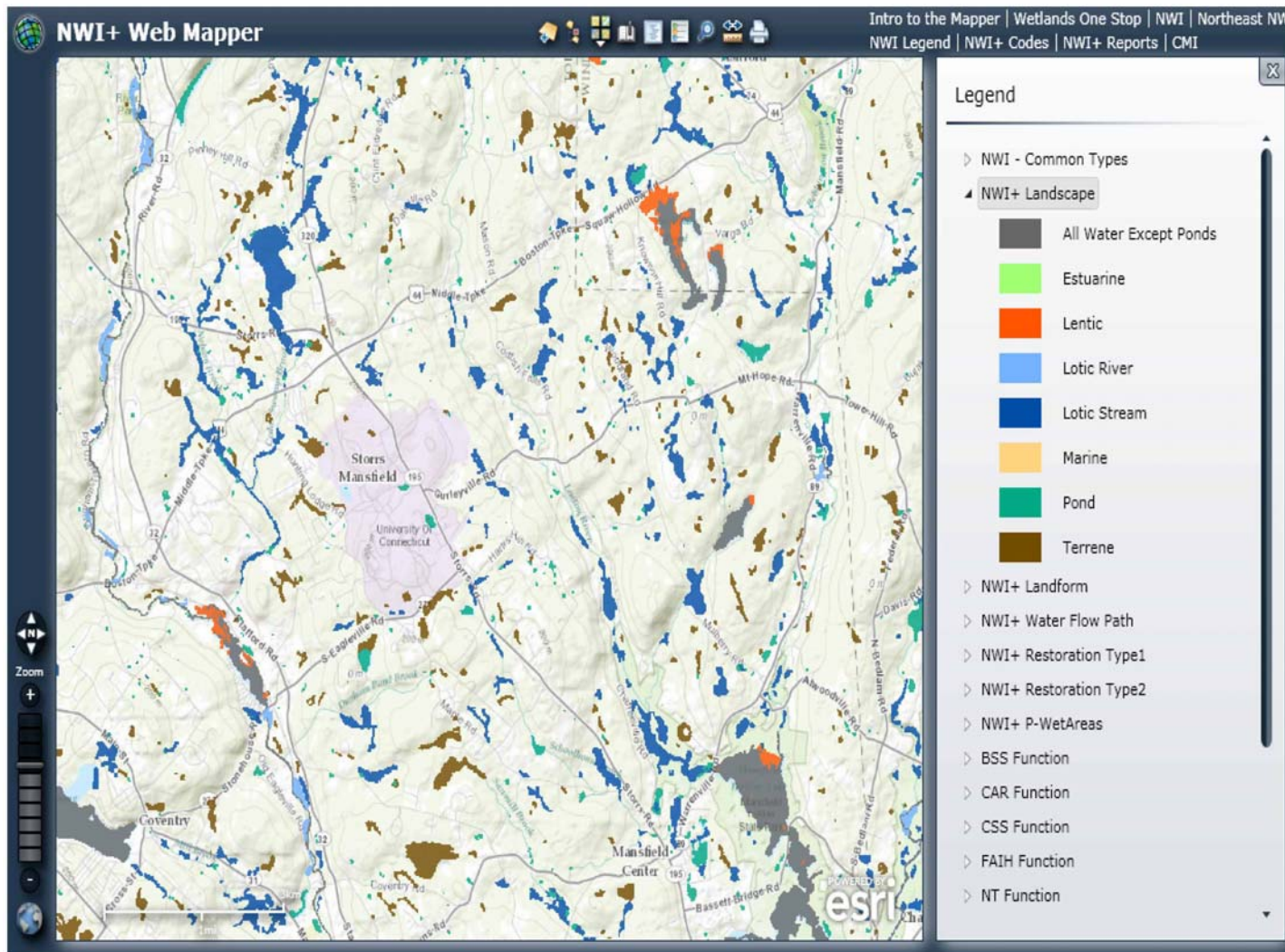


# NWI Types with Legend





# Landscape Position with Legend



# Landscape and “Wetland Code” Table

The screenshot displays the NWI+ Web Mapper interface. The main map area shows a landscape with wetlands highlighted in blue. A pop-up window titled "PEM1E" is open, displaying the following data:

NWI Attribute Code	PEM1E
LLWW Code	LS1BATH
Acres	15.133899777444

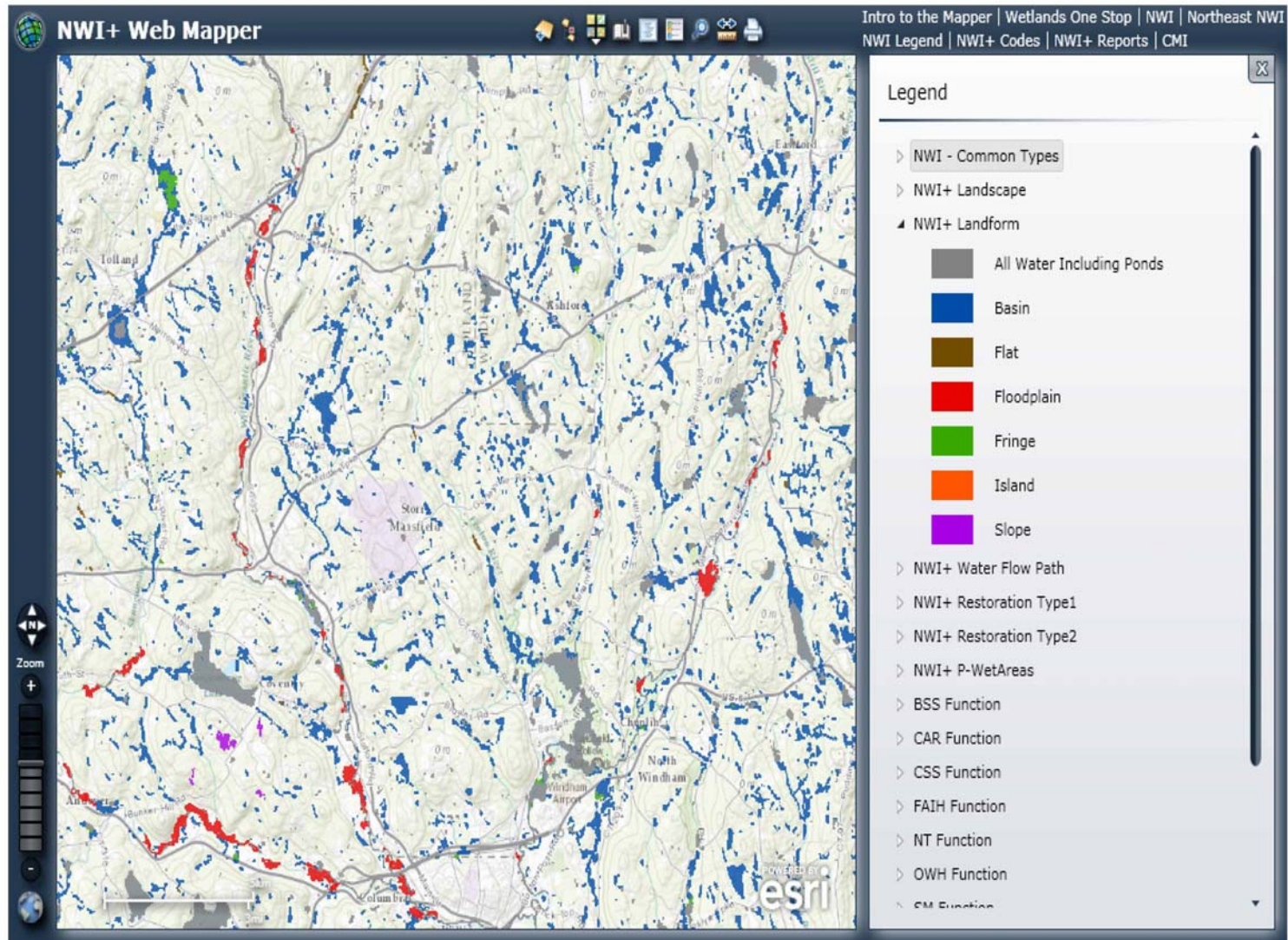
The right-hand side of the interface features a "Map Contents" panel with a list of layers and their status:

- ☒ NWI+ Footprints
- ☒ Wetland Codes
- ☐ NWI - Common Types
- ☒ NWI+ Landscape
- ☐ NWI+ Landform
- ☐ NWI+ WaterFlowPath
- ☐ NWI+ P\_RestType1 SoilCodes
- ☐ NWI+ Restoration Type1
- ☐ NWI+ Restoration Type 2
- ☐ NWI+ P-WetAreas Codes
- ☐ NWI+ P-WetAreas
- ☐ BSS Function
- ☐ CAR Function
- ☐ CSS Function
- ☐ FAIH Function
- ☐ NT Function

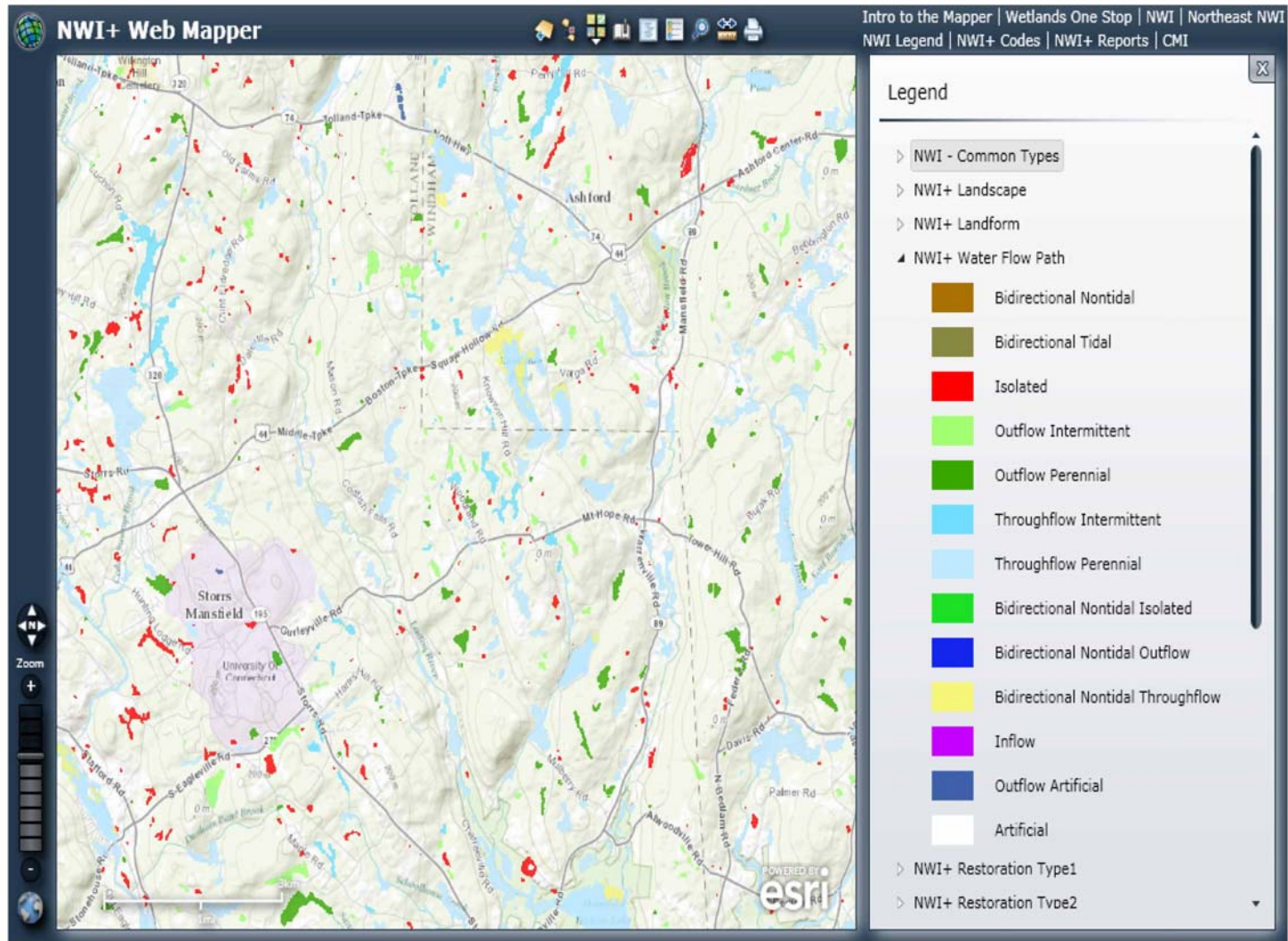
The interface includes a top navigation bar with links: "Intro to the Mapper", "Wetlands One Stop", "NWI", "Northeast NWI", "NWI Legend", "NWI+ Codes", "NWI+ Reports", and "CMI". The bottom left corner shows a scale bar (0 to 1000m) and the Esri logo.



# Landform with Legend

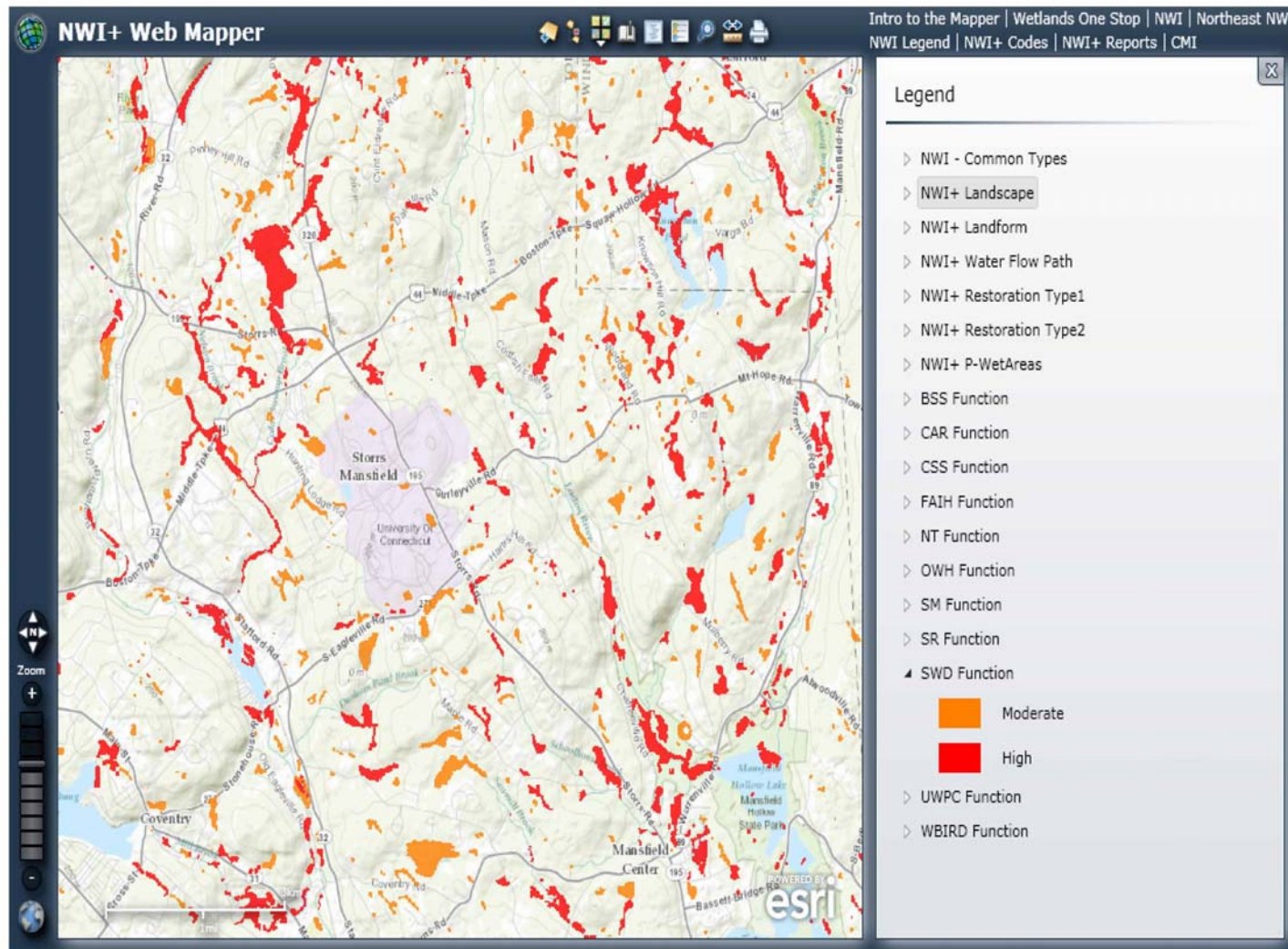


# Water Flow Path with Legend

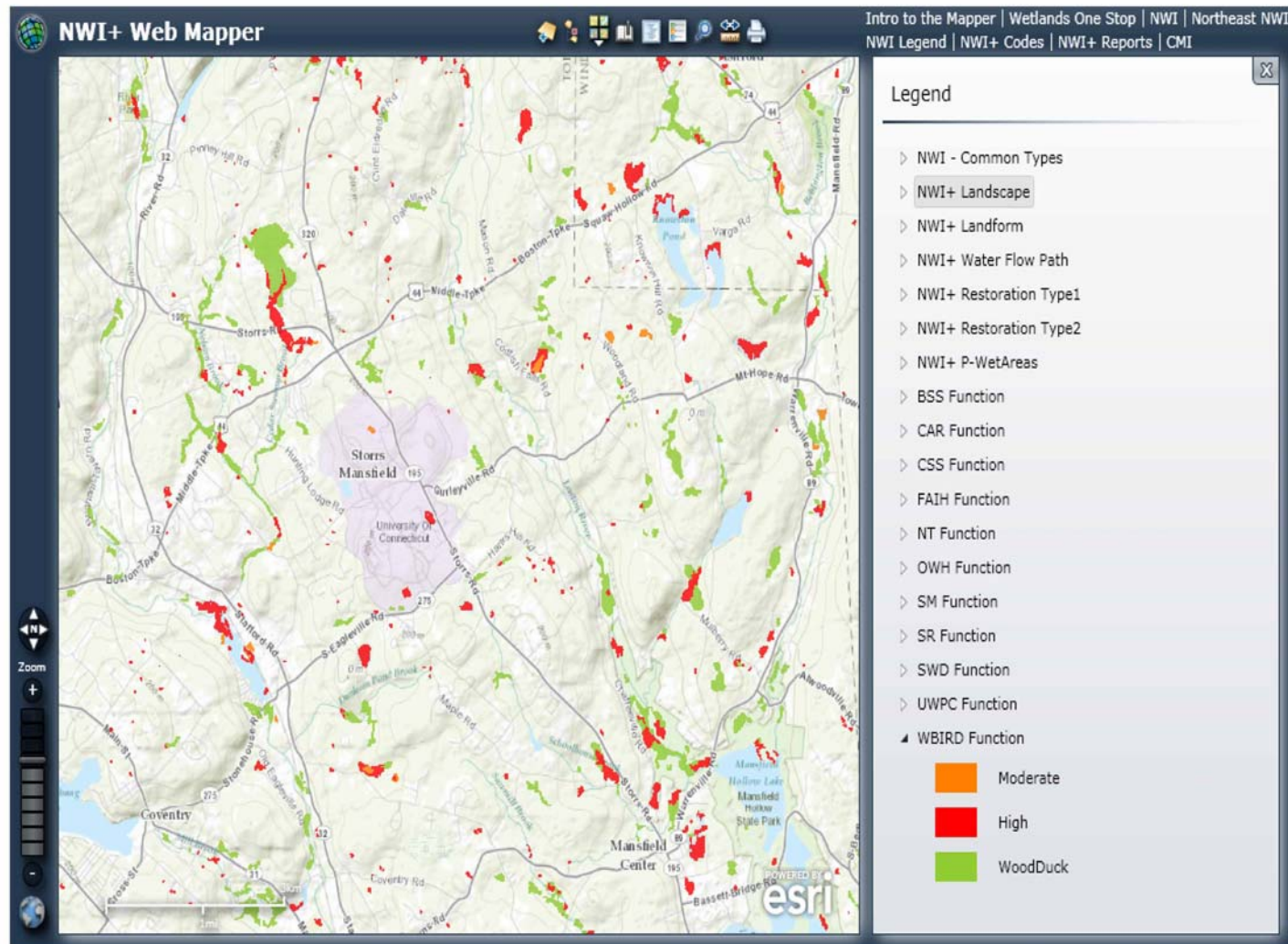




# Function Map – Surface Water Detention

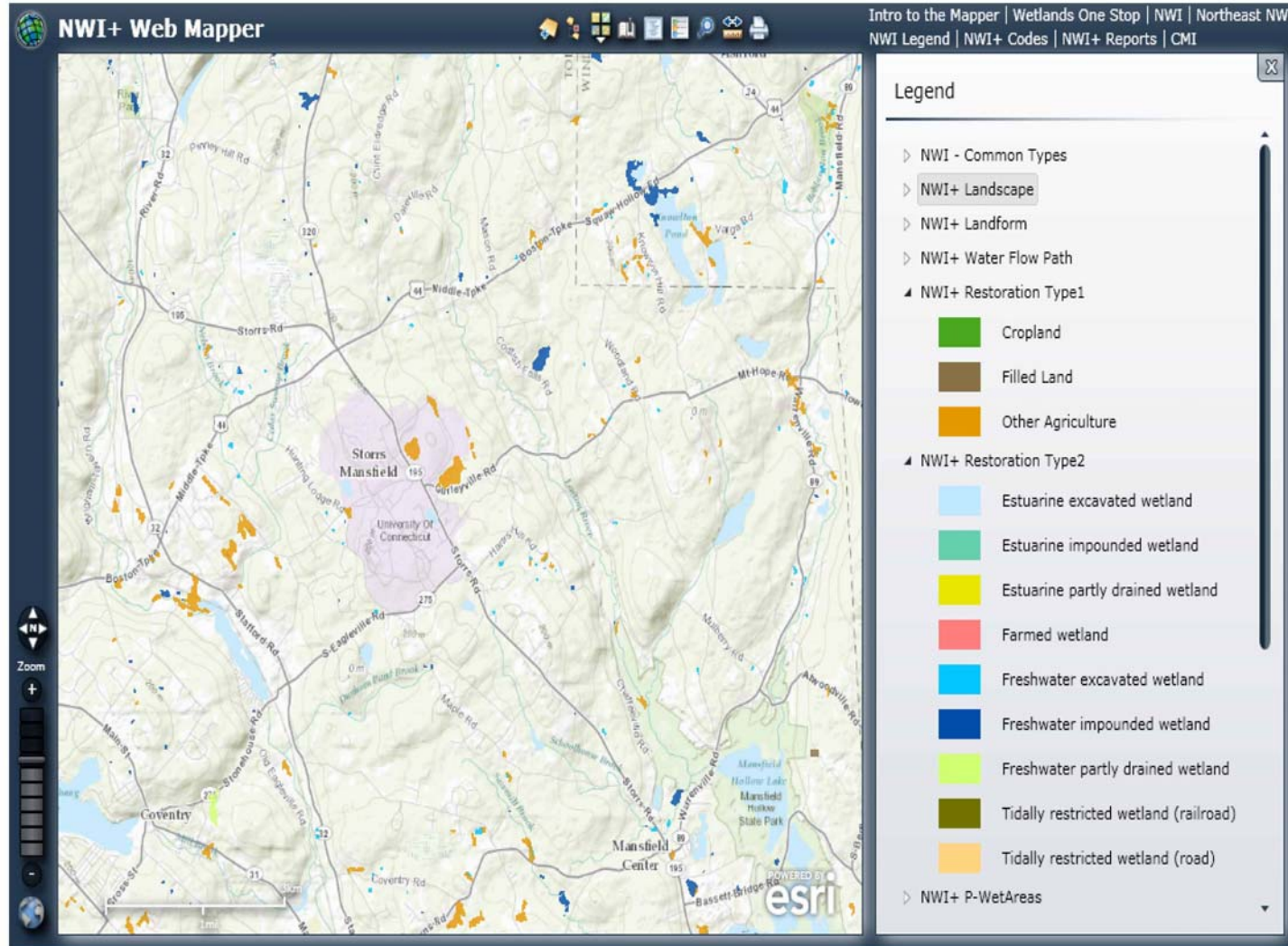


# Function Map – Waterfowl/Waterbird





# Optional Layer – Potential Restoration Sites



# Restoration Type 1 with Soil Type

The screenshot displays the NWI+ Web Mapper interface. The main map area shows several colored polygons: orange, green, and light blue. A pop-up window titled 'Raypol silt loam' is open, displaying the following data:

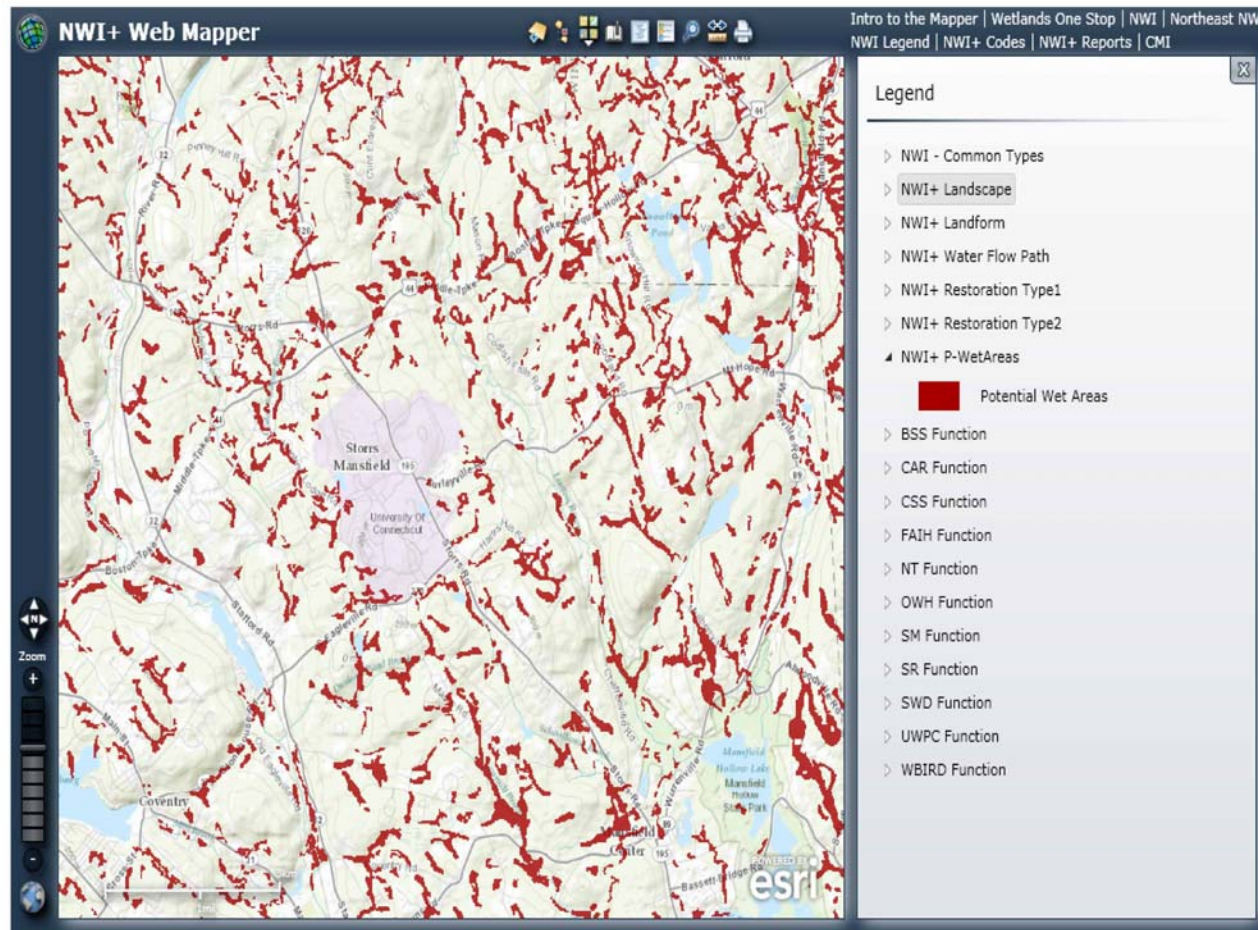
MUSYM	12
muname	Raypol silt loam

The right-hand panel, titled 'Map Contents', lists various map layers with checkboxes. The following layers are checked:

- ☒ NWI+ P\_RestType1 SoilCodes
- ☒ NWI+ Restoration Type1

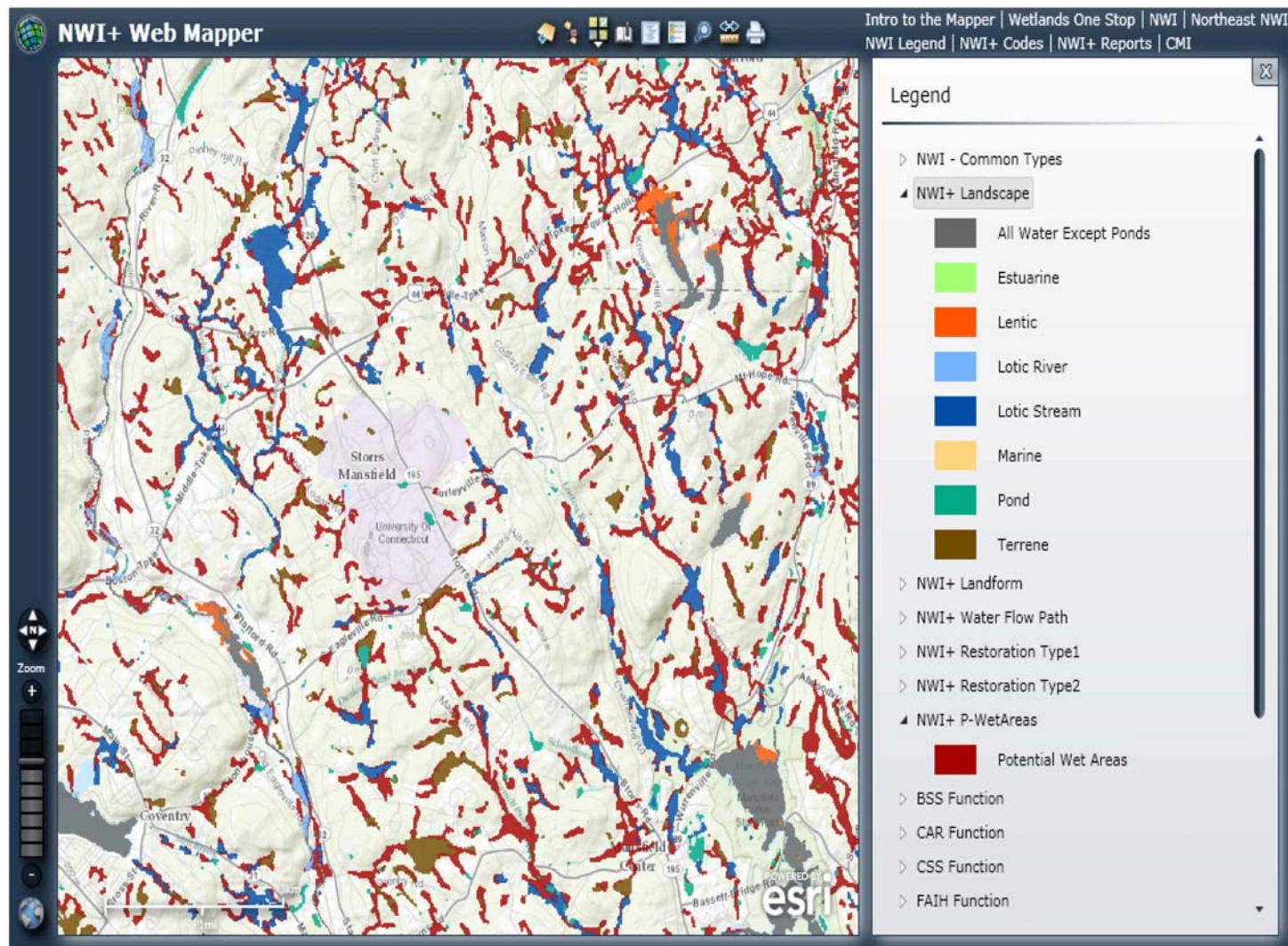
The bottom right corner of the map area features the 'POWERED BY esri' logo. The top of the interface includes navigation tools (compass, zoom, scale bar) and a header with links: 'Intro to the Mapper | Wetlands One Stop | NWI | Northeast NWI | NWI Legend | NWI+ Codes | NWI+ Reports | CMI'.

# Optional Layer – Potential Wet Areas (P-wet areas based on soil mapping)



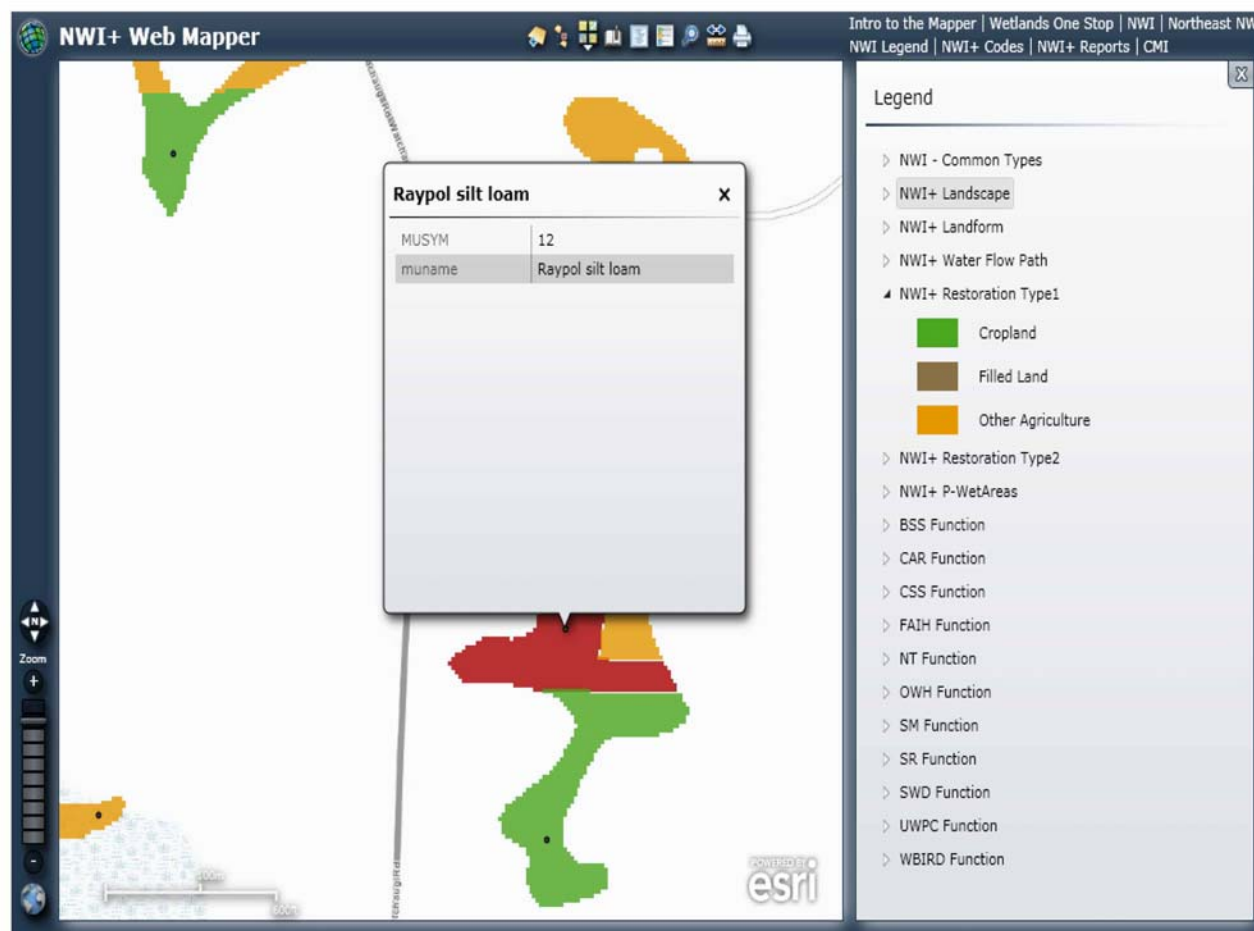


# P-Wet Areas and Wetlands (Landscape)





# P-Wet Area with Soil Code and Potential Type 1 Restoration Layer also Open



---

# Posting Data From Other Agencies

- Desire to use NWI+ Web Mapper or at least the “Wetlands One-Stop Mapping” site to help the others access this information
  - Work in progress
  - Definitely interested in posting data, but need data in compatible format
  - If can't post then will at least have symbol indicating availability elsewhere and give source in dropdown table
  - Can easily post any reports
-

---

# Support for Area-wide Functional Assessment (LLWW and NWI+)

- Center for Watershed Protection report “Using Local Watershed Plans to Protect Wetlands”
  - Mentions LLWW and watershed applications as a practical method for local wetland assessment using GIS
  - Included NWI+ techniques in another recent guidebook for local planners
  - Included NWI+ in their online “Wetlands-At-Risk Protection Tool”

<http://www.wetlandprotection.org/update-wetland-maps.html>

---

- 
- William Honachefsky's "Ecologically Based Municipal Land Use Planning" (Lewis Publishers)
    - NWI maps = most commonly used in municipal natural resource inventories
    - Recommends LLWW and functional assessment as a valuable tool for municipal planners. "...provide us with more details on the actual functions of individual wetlands – certainly valuable information for land planners...."
-

- 
- Federal Geographic Data Committee's (interagency committee) wetland mapping standard
    - lists as suggested data for future mapping (optional)
-

---

# Conclusion

- Enhancing NWI data increases the functionality of the NWI data
  - The NWI+ database can be used to predict wetland functions for geographic regions of variable size (even statewide landscape-level assessments)
  - The application of LLWW descriptors to wetland trends data and potential wetland restoration site inventories provides valuable information that can be related to wetland functions
  - NWI+ data help researchers and managers in selecting reference and study sites for monitoring wetlands
  - While NWI+ is a useful tool for wetland managers, it is important to remember that it is not intended to replace the need for site-specific assessments and investigations.
-



---

# Acknowledgments

Thanks to Kevin McGuckin (VTech) and Andy Robertson (St. Mary's University of MN) for supplying graphics of their work areas. Their programs have been instrumental in advancing NWI across the country.

Also a special thanks to all the agencies that have supported or are currently supporting application of LLWW descriptors to expand their wetland databases.

---

# Questions?

